Materials & Methods

THE MAGAZINE OF MATERIALS

Outlook in 1950 for Materials Supplies and Prices

Three New Steels Offer Higher Machinability Rates

Aluminum and Stainless Welded by Inert-Gas Metal Arc Process

New Vinyl Plastic Has Improved Heat Resistance

Nonferrous Metals Given High Finish by Chemical Polishing

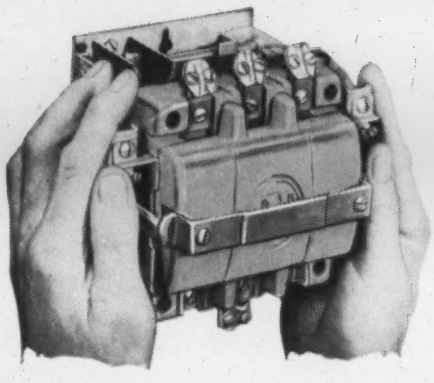
Dual-Purpose Salt Bath Cuts Steel Processing Costs

Copper-Base Alloys Combine High Strength and Conductivity

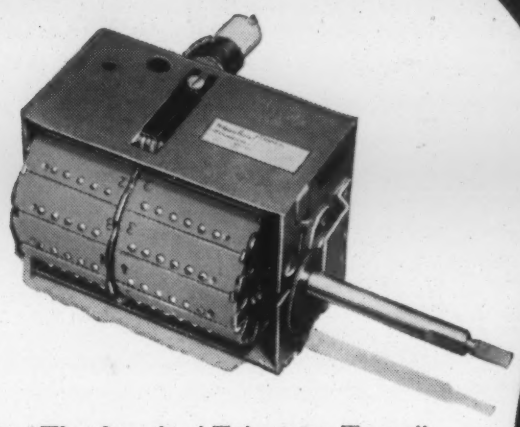
Materials at Work

Problems and Remedies in Heat Treating Stainless Steels

Identification of Metal Plate Deposits



In grueling interrupting current tests for arc resistance, Plaskon Alkyd withstood twice the current of the next best plastic. At that point, this starter motor, made by *The Arrow-Hart and Hegeman Electric Company*, still operated satisfactorily.

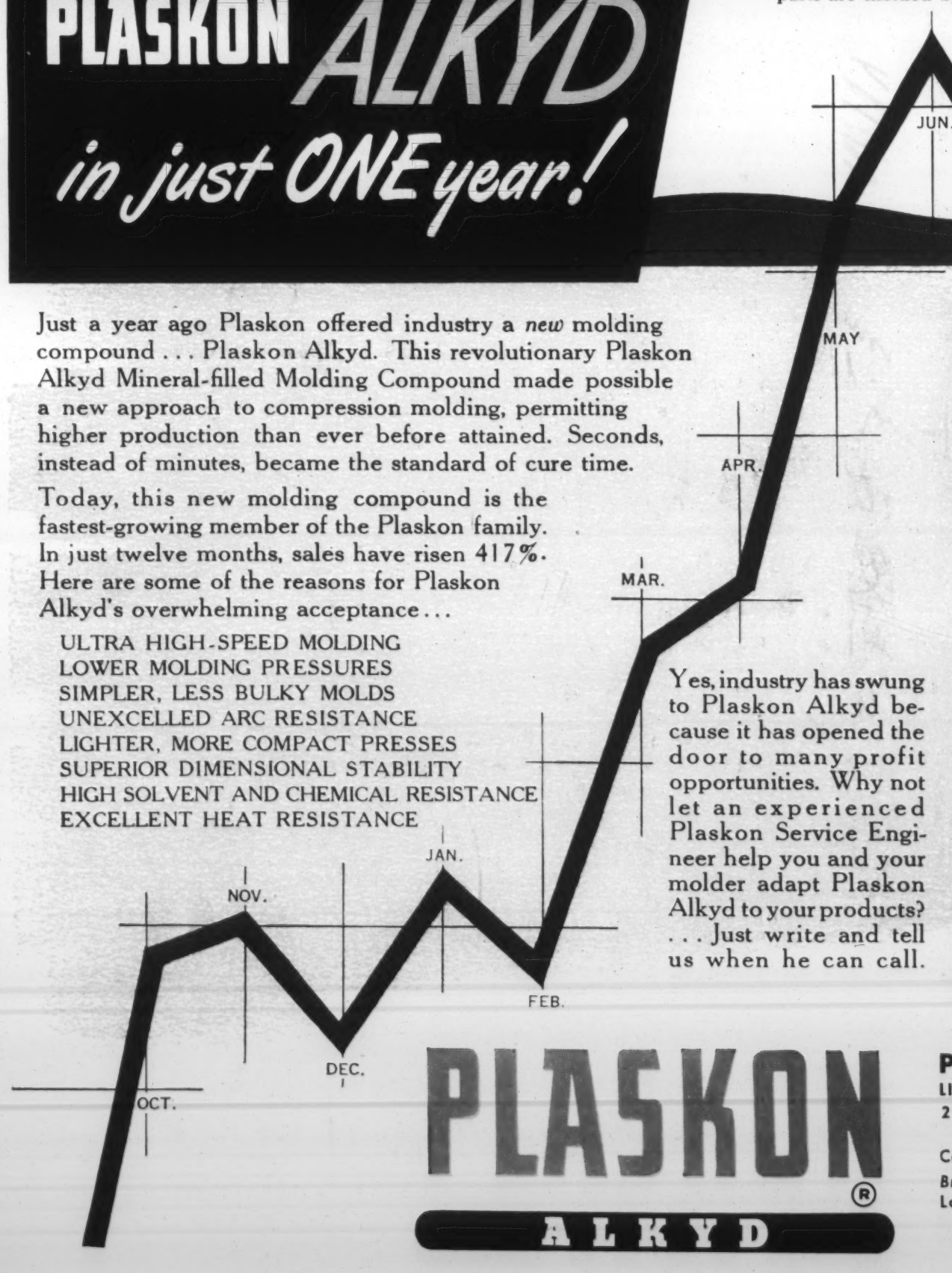


In "The Standard Television Tuner" extreme accuracy is of the utmost importance. Tolerances of molded Plaskon Alkyd parts used by *Standard Coil Products Company* are held as low as .0005". These Plaskon Alkyd parts are molded by *Wilcox Plastics*.

LOOK HOW INDUSTRY HAS SWUNG TO

PLASKON *ALKYD*

in just ONE year!



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EXCELLENT HEAT RESISTANCE

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Volume 31

January—June 1950, Inclusive

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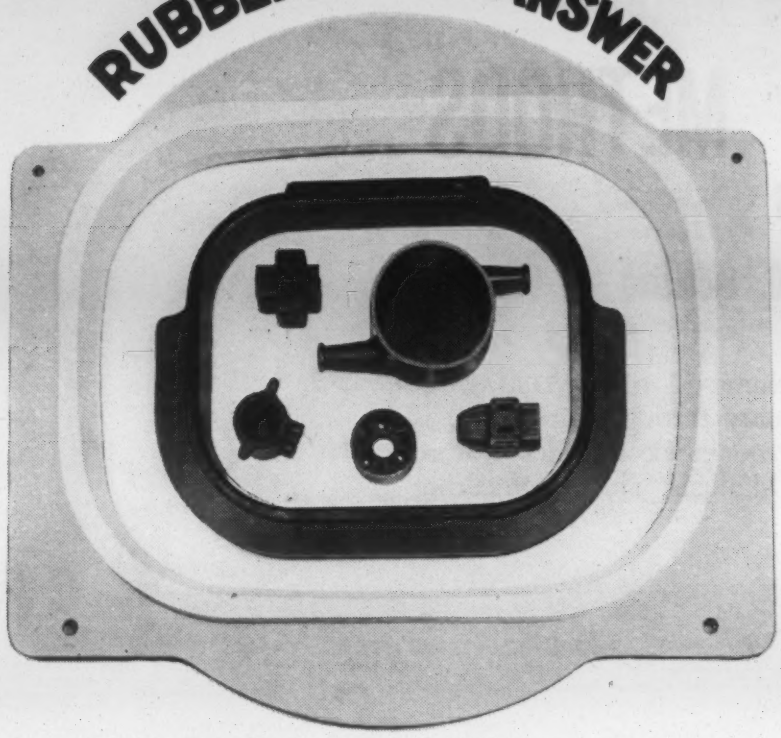

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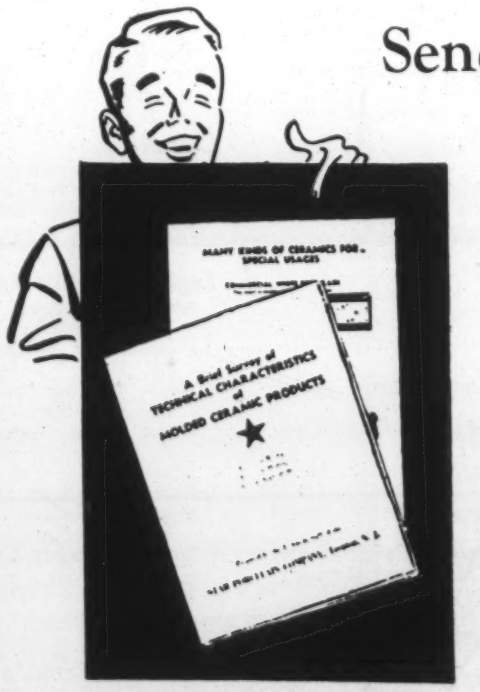

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The Materials Outlook

With the coal and steel troubles over, and at least a lull in other labor activity, business appears to have a clear track well into 1950. . . . A marked upturn in confidence is prevalent. . . . Metal products manufacturers, forced to curtail because of strike situations, now want to catch up. . . . Backlogs of demands are reappearing on the books. . . . Machinery and equipment producers are operating at high rates. . . . Automotive output, in low gear last month because of model changeovers, now nearing full throttle. . . . Construction industry contracts for '50 expected to shatter last year's highs. . . . All this adds up to good business. . . . The rebound has been strong . . . and the new year gets off to a good start.

Steel production is booming. . . . Operations are now topping the 90% mark, compared with the mid 80's before the strike. . . . Actual consumption is lagging, since strike-depleted inventories must be rebuilt and pipelines filled. . . . But backlog of orders continues strong and allocation of output will continue for some time yet to come. . . . Pricewise, steel is climbing again . . . rise in labor costs; rise in manufacturing costs; and fact that replacement costs must come out of profits are chief reasons.

And speaking of steel, new U. S. sources of manganese have payed off during past year. . . . Imports from Russia, formerly comprising up to one-half our total needs, were cut off by the Kremlin at height of "cold war". . . . To meet our heavy requirements, deposits in South Africa, India, South America, etc. were developed with U. S. aid. . . . These centers are now providing about two-thirds of the 700,000 tons we need annually; a year ago, they handled less than one-third our needs. . . . In addition to being outsmarted, Russia has thus lost another round in the current economic bout: the machinery, tools, etc. she formerly traded with us for her manganese, and perhaps more important still, the loss of world wide domination, manganesically speaking, since U. S. development of other sources has shrunk the overall market for the Russian product.

Copper continues tight, with biggest demands being made for wire, strip and sheet. . . . Last quarter strikes in '49 coming on top of an already tight market put this metallic on the spot. . . . With no expected slackening in demand during months ahead, situation shows no appreciable possibility of improvement in next few weeks.

New uses for metal powders are increasing. . . . Latest application is for jet-engine fuels. . . . Aluminum and magnesium powders have been used to replace conventional petroleum fuels. . . . But no aircraft, powder-powered, has flown as yet. . . . Research continues, however, with present work centered on heat-release calculations. . . . No information is available as to which of the two powders is more satisfactory.

And while on the subject of magnesium,

(Continued on page 4)

The Materials Outlook *(Continued)*

increasing use of the light metal has spurred the construction of a new magnesium rolling mill in the Detroit area. . . . Capacity will be 500,000 lb. of sheet per month. . . . New plant is expected to be in operation about September, 1950. . . . Among newest magnesium applications are: concrete forms, printing plates, trailer floors, etc. . . . Light-weight, resistance to fatigue, and good machinability of the metal caused Navy to specify it for transmission cases, control quadrants, pitch arm, and other control parts in new XHJP-1 utility helicopter.

The corrosion, set, and fatigue resistant alloy originally developed by Elgin National Watch Co. for mainsprings has now been utilized for still another application: Springless-scale tape. . . . This revolutionary, light-metal alloy is being used in an apparently ever-increasing number of applications ranging from springs and flapper valves to vibrating reeds, pivots, and fountain pen nibs.

Among the fastest growing engineering materials, from point of use, are the plastics. . . . Through continued research, these versatile compounds are being developed and applied to perhaps the widest range of industrial products possible. . . . And in this tremendous spread, early errors of misapplication are being corrected, not only in the laboratories and shops, but in the consumer's mind as well. . . . Newest among these widely divergent uses are molded washing machine agitators which replace the cast aluminum types formerly used. . . . New units retain good surface luster and finish after repeated immersions in hot soap and detergent solutions, and provide high impact strength, light weight, and low moisture absorption. . . .

And speaking of these applications, plastics in combination with other materials are opening up even wider fields for product specification. . . . Cases in point: Brake linings and clutch facings of woven asbestos tape fused with phenolic resins give over twice the life of previously used materials. . . . Plastic-coated paper for milk containers provides durable, sanitary, and leak-proof material at low cost.

A newcomer in the alloy steel family is the new "low-carbon" type of stainless for industrial use. . . . Carbon content is reduced to 0.03%. . . . Chromium and nickel stay at 18:8, respectively. . . . Reduction of carbon eliminates need for addition of columbium or titanium to austenitic stainless as "stabilizers" to minimize adverse effects of carbon . . . also reduces chance of intergranular corrosion. . . . Specimens of new alloy have been boiled in 65% nitric acid for 240 hr. without corroding between the grains. . . . Boiling for 500 hr. in copper sulfate and sulfuric acid didn't produce corrosion, either. . . . Acid tests were made after steel had been heat treated at temperatures ranging from 1000 to 1625 F.

Adding impetus to present popularity of copper is the new copper paste developed by Metals Refining Co. for furnace brazing operations. . . . Known as "Cubond," this paste provides a source of copper that can be applied with more speed and less waste than rings, foil, slugs, electroplate, and other conventional sources. . . . Applicator guns also developed to apply new paste as an extrusion in rounds or ribbons in varying quantity, depending upon trigger setting. . . . Neater joints and reduced cleaning are claimed. . . . Addition of small amounts of finely divided iron powder to paste form a cementing compound useful where loose fits for expansion purposes are required. . . . Cement action holds copper in place, fills cracks or loose joints, and provides fillets of desired size.

News Digest

Recent Seminar Underlines Importance of Plastics to Armed Forces

The importance of plastics to the armed forces was brought out in a series of papers presented before the Plastics Seminar sponsored by The Society of the Plastics Industry, Inc., and held at Washington in November.

Applications and problems of plastics in aircraft were discussed by three speakers from the Air Materiel Command, Wright-Patterson Air Force Base. According to W. G. Ramke, low-pressure laminates are being used successfully in three classifications: (1) those requiring dielectric properties, such as radio and radar antenna housings; (2) relatively lightly stressed parts which can be produced more cheaply and with less weight from plastic than metal, such as ducts, fairings and wing tips; and (3) parts where the gun-fire characteristics are advantageous compared to metal, particularly backing for self-sealing fuel and oil tanks.

Transparent Plastics

Research on transparent plastics for the Air Force is centering on the development of a thermoplastic suitable for use up to 250 F, according to W. R. Koch. Further studies in thermal decomposition are needed to assure a material of reproducible stability; and additional experimentation is necessary to establish methods of casting sheet plastic without compromising its properties. The problem of developing a heat-resistant plastic is accompanied by the closely related need for a suitable specification method of evaluating heat resistance, Koch pointed out.

The need for improvements in foamed plastics for foamed-in-place sandwich radome (protective housing for aircraft radar antennas) applications was stressed by Fred H. Behrens. Specific improvements asked are: (1) practical construction in graded thickness; (2) minimization of sandwich skin-core bonding resin layer; (3) elimination of core gaps, resin pockets and other discontinuities; and (4) precision control of dimensional and material uniformity. Other objectives listed by Behrens include development of rain erosion-resistant dielectric materials and of thermally stable, general-purpose dielectric materials. Both Ramke and Behrens emphasized the importance of developing materials with higher resistance to rain erosion.

An extensive plastics program on the ground was indicated by A. W. Van Heuckeroth, of the Materials Branch, Corps of Engineers. A partial list of Corps items fabricated of plastic in whole or in part includes landing mats, bridges, boats, and water and gasoline tanks and hose. Among problems of special interest to the Engineers are: (1) increasing resistance of plastics to impact and abrasion; and (2) developing a method for making a low gloss vinyl film without having to coat the surface of the film by a special operation.

Ordnance Requirements

Problems of interest to the Army and Navy ordnance departments were covered by Lucius Gilman, of the Ordnance Dept. Plastics Laboratory, and Albert Lightbody, of the Plastics Div., U. S. Naval Ordnance Laboratory. Specific developments anticipated by Gilman include: method for putting ends on glass base laminate tubing in order to obtain high resistance to internal pressure; method of determining whether polyethylene has been properly heat-sealed; manufacture of extruded cellulose acetate tubing; liquid polymers which can be cured below 120 F; tough polyester resins; and dip-coating polymers to be applied without use of elevated temperatures. Of special interest to Lightbody are plastics used in radar or other target-distinguishing devices, and plastics having extremely high shockproofness. Two areas in which further study is needed are: (1) behavior of plastics under high loading stress; and (2) the problem of metal inserts, or metal to plastics attachments, or plastics to plastics joints.

Use of a casting resin to obtain a permanent, durable, and three-dimensional reproduction of the surface of machine parts was described by John W. Sawyer of the Bureau of Ships. Experience has shown this method to be entirely satisfactory for indicating general wear patterns and recording surface finishes with extreme accuracy, according to Sawyer. This development is described in more detail on page 110 of this issue of MATERIALS & METHODS.

Use of Radioactive Tracer Solves Problem in Electroplating Study

A long-standing problem in electro-chemistry has been solved by use of radioactive tracer techniques, according to a recent announcement by the National Bureau of Standards. By tagging either the trivalent or

A staff member of the Bureau of Standards is shown placing a Geiger counter inside a tube upon which radioactive chromium 51 has been deposited.

the hexavalent chromium ion in a chromic acid plating bath with radioactive chromium 51, Fielding Ogburn and Abner Brenner were able

News Digest

to show that metallic chromium is deposited out of the bath from the hexavalent state, rather than the trivalent state as previously suggested.

Earlier studies had shown that, initially, all the chromium in the plating solution is in the hexavalent state. When the current is applied, however, an excess of some trivalent chromium is formed by reduction of the hexavalent chromium at the cathode. These observations led to numerous investigations into the mechanism of the electrodeposition process to determine whether the chromium is deposited directly from the hexavalent state or through the trivalent form.

The Bureau's results, obtained through use of a soft gamma ray emitter with a half-life of about 26 days, represent the first proof of the former theory. They also serve to demonstrate the utility of tracer methods as a tool for research on industrial plating problems.

Electrical Industry to Experience Broad Progress in Next 50 Years, Editors Told at Mid-Century Forum

Progress on a broad front in the electrical and related industries in the next half-century is expected by A. C. Monteith, vice-president in charge of engineering, Westinghouse Electric Corp. This look ahead was a summary of the views of Westinghouse engineers participating in the company's Mid-Century Review and Forecast Forum held in November at Pittsburgh. More than 50 technical editors were present to see "where the power and electric industry has been and where it is going."

Continued progress is seen as the result of new materials, new fabricating and processing methods, and improved application engineering. Among materials developments which have contributed to recent progress are improved high-temperature alloys, better enamels for wires, higher temperature solid and liquid insulations, and improved electrical steels.

The next half-century should see turbines, generators, transformers and circuit breakers of greatly increased capacities, but not necessarily equally increased dimensions, according to Monteith. Thus, turbines up to 200,000 kw., power transformers considerably larger than 145,000 kva. in a single tank, and voltages above the present high of 287,000 v. are visualized. This growth will accompany an expected several-fold increase in the use of electric power.

Other advances predicted are: superior heat transfer as a result of new gases, gases under pressure, and possibly evaporative cooling; a drive that is both motor and its control, built as a completely self-protecting unit; continued improvement in incandescent, mercury and fluorescent lighting; extension of radar principles to microwave communication; greater application of radio frequencies to induction and dielectric heating; and higher power electronic tubes at higher frequencies. Important advances in connection with the gas turbine and atomic energy are also predicted.

Tin Coating Thickness in Plating Continuously Indicated by Meter

A meter which makes possible more uniformly coated electrolytic tin plate by continuously indicating and recording tin coating thickness on steel strip during the plating operation has been developed at the Research Laboratory of Carnegie-Illinois Steel Corp. The instrument is now in regular use on all "Ferrostan" electrolytic tinning lines of United States Steel, and application for patent has been filed.

The new thickness meter, which is calibrated in terms of coating weight, operates independently of other control instruments on the lines. The instrument can be used to operate an alarm when the coating weight deviates from the specified value, or it can be set to control coating weight. The operator can change from one ordered coating thickness to another merely by adjusting the plating control dials until the thickness meter indicates the desired coating weight.

The self-balancing potentiometer which indicates and records thickness is part of an electrical circuit that correlates measurements of plating current, strip speed, strip width and plating efficiency. Previously, coating weight was tested by chemical means from sample sheets selected at intervals from the lines. Practical tests of the new meter have proved it to be as accurate as the chemical method.

A foreman is shown adjusting U. S. Steel's new thickness meter at a large tin plating installation at Irvin Works, near Pittsburgh.

Immersion in Fused Salt Bath Allows Successful Chromizing of Several Ferrous Materials

A process in which a variety of ferrous materials has been satisfactorily chromized by immersion in fused salt baths has been developed by I. E. Campbell, V. D. Barth, R. F. Hoeckelman and B. W. Gonser, of Battelle Memorial Institute *(Journal of the Electrochemical Society,* October). From a cost standpoint, this process is believed to compare favorably with other methods.

Since only the surface of a corrosion resistant alloy is effective in opposing destructive attack, ordinary iron or steels having protective high-chromium alloy surfaces are often just as satisfactory as "stainless steel" structures. Recognition of this fact has led to the development of the various chromizing processes in which a protective case containing from 40 to 70% chromium at the surface is produced by heating the base either in contact with chromium metal or in an atmosphere containing a chromium halide.

The principal method now in use is the pack process in which a chromium-containing mixture is packed around the parts in a tubular furnace, and the charge is heated to 2370 to 2550 F in a hydrogen atmosphere. A much more flexible process, however, is the salt bath method used experimentally in Germany during the war; in this process, chromizing is obtained by simply immersing the

work in fused salt containing chromous chloride.

Among the obvious advantages of the salt-bath method are greater latitude in chromous chloride concentration during treatment, elimination of packing and unloading operations and furnace heating and cooling, and the possibility of chromizing, simultaneously, articles requiring different periods of treatment. Because of these advantages and prevailing interest in chromized steels as replacements for strategic materials in aircraft, the Army Air Force's Air Material Command launched a research program at Battelle in 1948 aimed at determining the feasibility of the process.

The authors obtained satisfactory results at temperatures from 1650 to 2200 F by immersion in fused salt baths containing from 5 to 30% by weight of chromous chloride. They found that the rate of case formation is equal to or greater than that obtained with the various pack methods at corresponding temperatures.

As in other chromizing methods, the effectiveness of the fused-salt process was found to be dependent, to a considerable extent, on choice of material. Deeper penetration at lower temperatures requires the selection of lower carbon steels. Silicon apparently increases the diffusion rate, but the specific effects of other elements, alone or in combination, have not been determined.

Materials chromized in this investigation are Armco iron, two cast irons, a silicon steel, a stainless steel, "IK" type steel, and SAE 1015, 1045, 2315, 3140, 4120, 4130, 5115 steels, as well as nickel, molybdenum and tungsten.

British Study Gas Weld Porosity in Aluminum-Magnesium Alloys

Reduction of the porosity of the base metal immediately adjacent to gas welds in aluminum-magnesium alloy sheet by using purer materials and proper filler rods was described by J. Pendleton in *Transactions of the Institute of Welding* (August). Research was directed by a joint committee of the British Welding Research Association and the British Non-Ferrous Metals Research Association.

The high strengths of wrought aluminum-magnesium alloys containing up to 7% magnesium in the wrought annealed and as-cast conditions have made them of interest as strong weldable alloys. When welded, however, the alloys tend to develop gas porosity in the metal adjoining the weld. Research by the Non-Ferrous Metals Research Association has shown this porosity is due to the reaction of the metal and water vapor at elevated temperatures. Some of the atomic hydrogen formed diffuses into the metal and is rejected as molecular hydrogen at suitable interfaces.

Results of this latest investigation show that the extent of porosity increases with magnesium content and with exposure time at high temperature (or decreasing welding speed). It is also affected by the amount of certain impurities present, notably calcium. It is known that sheet contaminated with calcium usually has a relatively high initial hydrogen content, and it is believed these impurities may promote gas pickup during welding. According to Pendleton, commercially-produced materials having high calcium and hydrogen contents gave porous welds with low mechanical properties. Laboratory-produced sheet having low calcium and hydrogen contents was welded in thicknesses up to 10 s.w.g. and with magnesium contents up to 7%, without developing gas porosity. These welds had good mechanical properties.

Constrained welds in alloys of low magnesium content, i.e. 2 or 3%, have sometimes resulted in cracking. Investigation showed this difficulty could be avoided by use of 5 or 7% magnesium alloy filler rods.

News Digest

Recent Advances in Welding Discussed at AWS Annual Meeting; Inert-Gas-Shielded Arc Process Receives Special Attention

At the 30th Annual Meeting of the American Welding Society held in Cleveland in October, approximately 70 papers covering all phases of welding were presented. Following is a brief review of a small portion of these papers.

Inert-Gas-Shielded Welding

Interest in inert-gas arc welding is still running high, as witnessed by the fact that no less than six papers were devoted to the subject. In "Heliarc Welding of Aluminum Alloys," F. H. Stevenson described the importance of this welding process in the metal-spinning industry where the weld metal must withstand the same severe cold-working as the base metal. The fundamental advantages of the process in this work include: (1) no flux required; (2) cleaning and grinding costs are a minimum; (3) welds can be made with or without filler rod; and (4) lack of sparks, smoke and spatter makes for ease of operation and lower rod cost. Both the heat-treatable and non-heat-treatable alloys have been successfully welded for spun products.

M. J. Conway, in his paper "Applications for Helium in Inert-Arc Welding," stressed the advantages of the use of helium in this welding process, and predicted its wider use in the future. At present the widest use of helium is in the inert-gas-shielded tungsten arc welding of stainless steel. Helium is also widely used for welding nickel alloys, copper and high-copper alloys. This gas, however, is not used to any great extent on aluminum.

F. Albrecht conducted an investigation into the economic aspects of inert-gas arc welding for joining aluminum, and reported his results in the paper "Shielded Arc Welding of Aluminum." He concluded that the method is economically justified whenever sufficient work is on hand to permit continuous utilization and where a capital expense of about $2200 is possible.

A short paper by H. E. Gannett, "Heliarc and Railroad Applications," outlined uses of the process in the railroad field. And another short paper, "Inert-Gas-Shielded Arc-Welding Aluminum Pressure Vessels," by A. J. Hopper showed how the process under proper procedure control can assure welds of excellent quality and appearance on complex weldments and vessels of aluminum. (For a review of other late developments in inert-gas-shielded arc welding, see the article in this issue of MATERIALS & METHODS, p. 53).

Spot Welding Galvanized Steel

Although spot welding has long been accepted as an economical and

(Continued on page 112)

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METALLURGY SALES OPERATIONS

Outlook in 1950 Optimistic for Materials Supplies and Prices

Review of the past year and a look into the coming one indicates that the better supply and generally lower prices attained during the year will continue with not much change in 1950.

by N. BRUCE BAGGER,
Associate Editor, Materials & Methods

• MOST OF THE question marks in the minds of both materials users and producers at the beginning of 1949 have, by now, largely disappeared. The uncertainty, the doubts, and the general uneasiness that permeated the materials picture a year ago has been dissipated to a great extent during the past 12 months by the fact that the demands that were then so pressing have been satisfied, and in the satisfaction of these demands, a somewhat more normal balance between them and supply has been restored, at least to the extent that a more or less competitive price structure has been re-established.

Marring this rather optimistic condition, of course, is the labor situation. Hardly a single material producer has escaped the effects of a strike or walkout of one sort or another during recent months. Whether these disruptions have occurred in his own plants or in those of his suppliers matters little, since the effect has been largely the same. The widespread curtailment of production that results from shutdowns such as we experienced during the closing months of the year cannot help but be reflected in the tone and tempo of the overall business picture. And everyone is affected in varying degree. In these disruptions, wages appeared to be relegated to secondary points of dispute, with pensions and social insurance demands occupying the negotiation spotlight. The costs of these benefits must come from somewhere, and if too burdensome to the producer, will without doubt be eventually passed on to consumers in one form or another. The net effect of all this could mean a rising price level from the lows to which the level declined last summer. Already, materials prices in certain fields have climbed somewhat above the low level reached when supply essentially balanced demand, although these increases, at least to date, haven't reached the peaks established at the height of the shortage.

The acute pessimism present during the opening months of the past year was caused largely by the upward spiraling price movement and by the gradual cessation of buying that such movement engendered. This condition fed upon itself and multiplied. Commitments were reduced as far as practicable, and virtually everyone battened down the hatches to ride out the blow. The recovery that took effect in the early summer and continued unabated to the wave of strikes in the fall was powered, of course, by the fact that inventories were eventually eaten up, stocks had to be replenished, and commitments replaced. The weakness of this recovery, however, lies in the fact that it has been largely confined to consumer goods and has been based on refilling pipelines. To this extent, the pickup may possibly lose momentum when replenishment has proceeded as far as buyers think advisable. Softening prices in some lines already give evidence of this.

But prosperity notwithstanding, current sentiment is unlikely to lead to recklessness, since fundamental reasons for caution exist. An upturn in activity such as we have experienced since a year ago might, under normal circumstances, be followed by an increase in business spending for new plant and equipment. But the trend in this direction is downward because of the tremendous outlays for this purpose during the past three years. Also, continued readjustments can be expected to characterize business activity between now and the middle of the new year as both producers and consumers feel their way along. There is every reasonable expectation of a moderate production decline in the basic materials industries in the first half of the new year. But this, in turn, will be followed by a general rise in the final quarters.

The labor factor is expected to reach some degree of stabilization once the currently muddied waters have settled. But there is overwhelming opinion prevalent at this time that the majority of industrial workers in all industries will receive benefits equivalent to wage increases during the year, now that the general pattern has been set.

From this general summary, let us consider the individual status of each major metallic material for the year ahead.

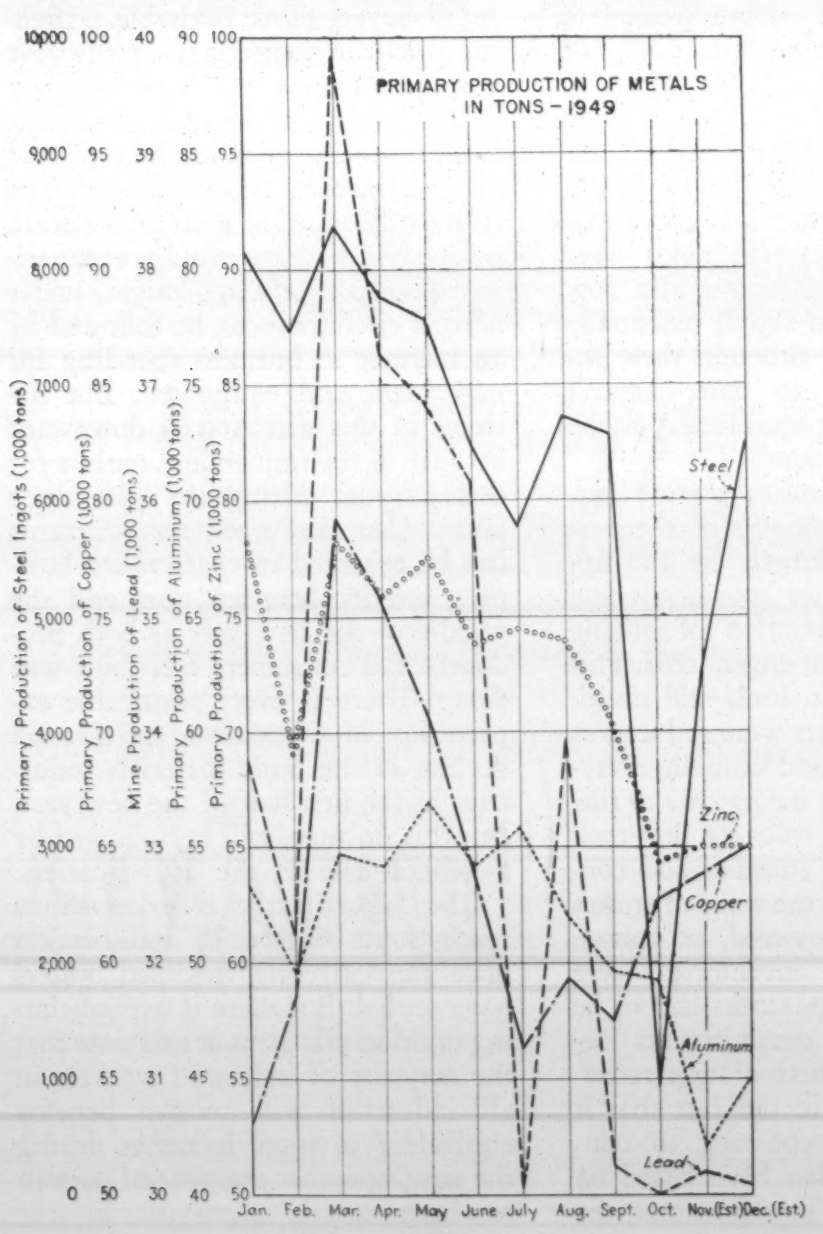
Steel

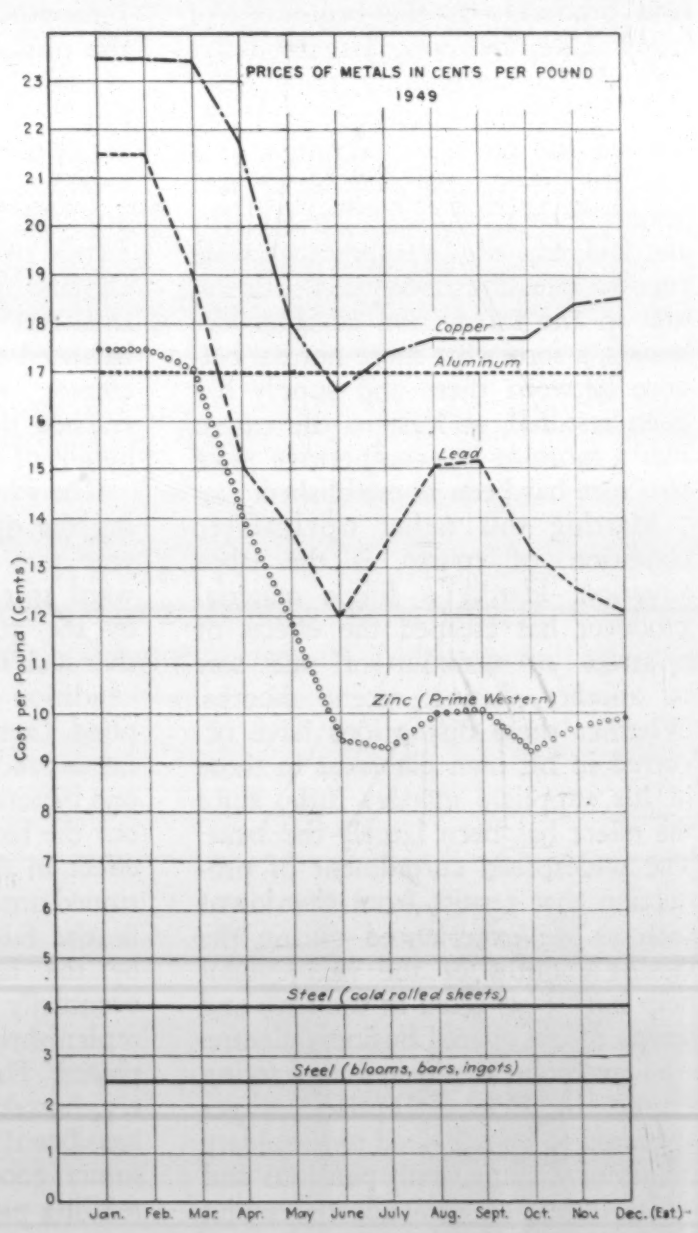
The record of the steel industry during the year just past has been little short of amazing. Faced with commitments and demands excessively greater than output and bedevilled by political and labor pressure both within and without the industry, the companies producing steel successfully achieved production goals that appeared insurmountable when originally set up. After establishing records for tonnage of output and percentage of capacity operated during the first and second quarters which fairly liquidated the existing backlog of demand, the level of activity gradually declined. This leveling was hastened in part by the growing restiveness of labor in re pension claims and other disputes, and culminated in the widespread shutdowns during the closing quarters of the year when output slumped to barely 9% of capacity.

Despite this second-half sag, production of ingots and steel for castings in the first half of 1949 made a record for any half-year at 45,928,000 tons, exceeding the first half of 1948 by over 2.8 million tons. Shipments of steel products in the first six months approximated 33,630,000 tons, a gain of nearly 1.4 million tons over the similar 1948 period.

The paralyzing strikes during the final quarters of 1949, of course, wiped out in a large measure the gains established in the opening months of the year. The backlog problem reappeared since it became virtually impossible for struck plants to process orders during the shutdown. Just how long it will be before the steel industry is able to get back to the pre-strike level is a matter of widespread conjecture. Even with all plants again in operation, considerable effort will be required to regain the ground lost as a result of the strike. To offset some of the difficulties encountered in meeting the pent-up demand, strict quota systems have been applied to the distribution of finished mill products. Consumers have been placed on a percentage rating related to their originally projected fourth-quarter (1948) commitments.

The price outlook for steel during 1950 is considerably clouded as a result of the strike situation. Had labor trouble not intervened, it is possible that steel prices would have dipped in 1950 as the production and consumption of mill products struck a satisfactory balance and competition became more stringent. But with the recent tie-up and all its associated difficulties, it is virtually impossible at this time to determine what effect the cost of pensions and social insurance will have on the per-ton cost of finished steel. The six-cent and four-cent program recommended by the Fact Finding Board last fall figured out to about $3 per ton higher costs in the case of a leading producer. But so many variables are in the picture that an overall figure cannot be intelligently given. Suffice it to say, however, at least a portion of these added costs will undoubtedly be passed on to the consumer and will have a deleterious effect on the price you pay for steel during the coming year.


PRIMARY PRODUCTION OF METALS IN TONS – 1949
Primary Production of Steel Ingots (1,000 tons)
Primary Production of Copper (1,000 tons)
Mine Production of Lead (1,000 tons)
Primary Production of Aluminum (1,000 tons)
Primary Production of Zinc (1,000 tons)
10,000 100 40 90 100
9,000 95 39 85 95
8,000 90 38 80 90
7,000 85 37 75 85
6,000 80 36 70 80
5,000 75 35 65 75
4,000 70 34 60 70
3,000 65 33 55 65
2,000 60 32 50 60
1,000 55 31 45 55
0 50 30 40 50
Steel
Zinc
Copper
Aluminum
Lead
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov.(Est) Dec.(Est.)


PRICES OF METALS IN CENTS PER POUND 1949
Cost per Pound (Cents)
23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Copper
Aluminum
Lead
Zinc (Prime Western)
Steel (cold rolled sheets)
Steel (blooms, bars, ingots)
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.(Est.)

Copper

The copper and copper-base alloy situation has see-sawed steadily throughout the past year from periods of drastic shortage to relative plenty. This has been caused, in part, by labor difficulties which beset the most active producers and by the fluctuating price picture of the overall metal market. As the economy of this market shifted, repercussions were felt throughout each of the component branches or sections; variations in demand occurring as substitutions among basic materials were made.

In all, however, copper fared reasonably well. Following the "corrective" movement of prices last spring when, it will be recalled, copper prices started slipping, the decline continued steadily until the advance in the late fall marked the definite return of the upswing. Buying picked up gradually over the summer months with wire, sheet and tubing accounting for the biggest gains. This activity culminated at years' end in exceptionally heavy buying on the part of price-conscious consumers who were in the market for much more copper than they ordinarily would buy, their trading spurred by recurrent rumors of still higher prices, sagging inventories, anticipated rises in scheduled freight rates, and undiminished threats of more labor trouble.

The copper outlook for 1950 is not too discouraging, however, for there is every indication that once an overall industrial pattern is evolved from the presently unsettled factors, production should go again into high gear and the temporary shortage in copper eliminated with none of the sky rocketing price structure that was prevalent a year ago. A further optimistic note in the copper picture for 1950 is the proposed plan of the British Ministry of Supply to purchase 15,000 tons of copper per quarter on a competitive bid basis. This is a departure from past procedure, in that Great Britain was previously assigned ECA funds to purchase specified quantities of copper in each country. All dollar sources will now be given the opportunity to bid, and this will have a tendency to keep the lid on the domestic price structure as far as copper is concerned.

There has been considerable interest shown by the United Kingdom in the revived strength of the copper market here in the U. S. during the past few months. This is largely because of the fact that, whereas the demand has ranged high on our side of the water despite strikes and other depressing tendencies, the general level of demand throughout England and Western Europe has been unimpressive. This situation could, of course, change rapidly, particularly if prices rose over here.

Copper and copper-base alloy scrap activity closed the year on a highly competitive note, primarily because principal consumers have shaved their purchases considerably under the levels of early '48. Smelting interests have been buying only what is actually needed, with speculative buying on the shelf at the present time. Some improvement has been noted in brass foundry operations, which while not outstanding, is contributing in some measure to the competitive scrap situation. In this connection, it is of interest to note that during the final quarters of 1948, scrap dealers shipped most of their brass to refiners because the melters were actively out of the market. Now, with melters reentering the picture and very little scrap available, the net effect is to firm-up the market for brass and copper clear across the board.

Lead

A year ago, the lead situation was in a sorry state. Demand ran well in excess of available supply, and prices were nosing higher as consumers attempted to obtain the metal by virtually every means. Today, lead is still in an unenviable position, but for an entirely different reason. The available supplies of the metal are now so plentiful that most consumers are favoring a moderate course in stocking it against future use. This swing from one end of the scale to the other was caused partly by the shift that took place in the overall metals picture during the past 12 months and partly by a revival of liberal offerings from foreign sources. These imports, the volume of which exceeded most industry expectations, were substantial throughout the year and, in some measure, reflected the success of our world rehabilitation program through ECA and other agencies. They did, however, succeed in toppling the price of lead from its peaks of a year ago and have contributed in no small way to the generally spongy price structure that has beset the domestic lead market since last fall.

At the present time, there is no indication that this condition will change, at least until the final quarters of 1950. Current demand for the metal is so low that consumers are making no attempts to stockpile against future market rises; ordering is being limited only to current commitments, since the feeling is that there will be plenty of lead available at present, or possibly lower, prices for sometime yet to come. There is the possibility, however, that a general rise in overall industrial activity during the closing months of 1950 will see a marked firming of the lead market. It should be noted, however, that the recent increased activity in copper has not spread to lead; thus, the mere presence of a boom in other segments of industry is not in itself always a guarantee of increased activity across the board. Continued imports of foreign lead at concessionary prices are almost sure to be a major factor in depressing prices of the metal in domestic markets during the coming year. These imports, while possibly not causing prices to fall much lower, will most certainly exert a downward pressure against any rises that might otherwise occur should the demand for lead suddenly swing upwards.

Aluminum

Aluminum is one metal that enters 1950 with at least some vestiges of last year's shortage. Although aluminum production boomed during the past twelve months and was only slightly hampered by strikes, comparatively speaking, demand also rose as more and more product manufacturers swung to use of the light metal. Since current aluminum output is held back by lack of adequate electric power and some work stoppages, and since the demands for this metal appear to be continuing virtually unabated, it is more than likely that a tight aluminum market will prevail for most, if not all of the coming year. In furtherance of this is the fact that although no Governmental purchases are planned for the current fiscal year, the metal has been placed on the list of strategic and critical materials. Governmental requirements will be met with delivery from the General Services Administration, since it is felt that this action will tend to alleviate the already tight situation that prevails at the present time.

Pricewise, aluminum should go along pretty much on its present course. But the possibility of changes should not be overlooked, particularly if a further downward price revision of competitive metals should occur.

Tin

The tin situation over the past 12 months has shown such considerable change in the shift from scarcity to relative plenty, that the regulatory orders of the Department of Commerce on the use of pig tin up to now have been eliminated except for periodic reports. This relaxation of the restrictions on imports, distribution and inventories of pig tin is in keeping with the previously stated intention of Washington to decontrol tin as soon as supplies appeared adequate to meet the needs of industry and of the strategic stockpile. In view of the overall tin market in recent months, the only question raised is why such decontrol was held up as long as it was. Since the supplies of tin during the final quarters of 1949 consistently exceeded consumption, industry spokesmen feel that the hoopla accompanying the action of the Department of Commerce was largely anti-climatic.

Despite strikes and attendant lost production in the mills of tin plate producers during the closing months of 1949, demand remained narrow and irregular. Fourth quarter output was about half the originally planned production; due in part, of course, to the stoppage at the mills and partly to the general lack of interest in the market. Hopes for 1950 are rising, however, as first quarter schedules are closing rapidly. Although order pile-ups during the six week steel strike were moderately heavy, it is expected that those can be cleaned up fairly quickly. Most emphasis, to date, has been on the 0.25-lb. and 0.50-lb. electrolytic plate. Present mill stocks are a bit below normal, since an unexpected wave of anticipatory buying occurred by consumers prior to the strike.

As far as domestic prices are concerned, 1950 should see a decline in tin costs, provided, of course, that market tightening doesn't occur, which isn't very likely. Considerable thought has been given to the possibility of reducing export prices for tin plate. Since export prices have ranged around 75c per base box higher than domestic prices, extensive jobber business has developed by outlets for export. In many instances, jobbers have undersold for export some of the established outlets of integrated tin plate producers. The mark-up of export prices in recent years was primarily caused by the exceptionally heavy demand for both export and domestic tin plate. However, with the difficulties in adjustment to the new monetary structures that have resulted from the devaluation of the British pound, export tin plate has been moving very slowly. A reduction in tin plate export prices would naturally speed this up and, at the same time, effect a more natural relationship between domestic and export costs, since it is more usual for export prices to be at or even below the level of domestic tin plate prices.

Zinc

Zinc is still another metal that enters 1950 in a condition drastically changed from what it was a year ago. Here, too, the picture is somewhat the same as for most of the other metals. The industry has not only overcome the pressing shortages that were present at the beginning of 1949, but has been plagued by strikes both within and without its own borders. The steel strike during the closing months of last year caused virtual cessation of galvanizing operations, which, in turn, were reflected in a decrease in zinc demand. Although die casting, another big consumer of zinc, has continued at favorable rates, the overall tone of the zinc situation has been far from what it was some months back.

So far as price is concerned, most, if not all of the business placed during the closing months of 1949 was either at a premium of 1¼c a lb. over Prime Western, or at the mean of the quoted range of 10.75c to 11.00c delivered. The 10.75c price remained in the picture primarily because some of the contracts that ran to the end of the year were drawn up on that basis and a considerable quantity of metal was delivered and billed at that price. But pressure at year's end was bringing these prices downward, with a possible leveling at just under 10c. Special High Grade zinc has continued at a reasonably heavy demand up to the close of the year, with scattered sellers reporting they are out of the market until such time as further supplies of the metal are forthcoming. Although these are the exception, it is nonetheless a healthy sign in the overall picture, as it shows that the expectations for 1950 are not as pessimistic as might otherwise be the case.

Plastics

The plastics industry likewise faces the new year with a healthy optimism born of the performance shown during the past few months. The sharp rebound that was experienced in compression molding following the slump that existed up to July, 1949 is expected to continue although at a slightly decreased rate of climb. Since thermosetting consumption is predominately earmarked for industrial parts and equipment, the pattern this segment of the industry takes follows the overall industrial picture pretty closely. Thus, the rebound has been partly caused by the rebuilding of inventories as business in general recovered from the setbacks of early last year.

The thermoplastics didn't experience the same slump, thus the rebound for these materials hasn't shown the vigor or strength of that of the thermosetting plastics. Since thermoplastics are used predominantly in consumer goods, there is an optimistic feeling present throughout the industry that business will stay good during the coming year. This feeling is engendered principally by the fact that there is still a tremendous amount of purchasing power still in the hands of the consuming public, and although the public is no longer hysterically buying without thought of price or quality, they *are* buying if the merchandise offered meets their approval.

Since the plastic industry is largely dependent upon all business for its relative strength, it is expected that pricewise, plastics will follow the course of other industries, *i.e.,* keep prices on an even keel with probably some reductions if they become possible. In this latter, the plastics industry tends to depart somewhat from the overall business scene. This is because plastics producers are largely mechanized and are not dependent upon labor to the extent that other materials producers are. Also, since most new plant and equipment has already been installed in the years following the war, there is small likelihood of price rises based on increased capital investment.

From this discussion, an overall note of optimism is clearly discernible in the economic position of the metals market. The contributing factors and their interdependence combine to make the outlook for the coming year much better than that of 12 months ago. Having largely purged itself of labor difficulties and having achieved a measurable degree of progress in eliminating acute scarcities, the metals industry is now in a better position to move into a new year than it has been for sometime past.

Three New Steels Offer Higher Machinability Rates

Increases in machining rates of at least 25% are gained with these new free machining steels developed during the past year.

• FOR MANY YEARS attempts have been made to provide steels which machined better—and consequently faster—than the standard group of AISI B series steels. During the last few months, three companies have indicated that they have been successful in such a quest by announcing new free-machining steels. All of them offer substantial production rates, with the most conservative claiming a machining rate 25% greater than comparable existing Bessemer steels.

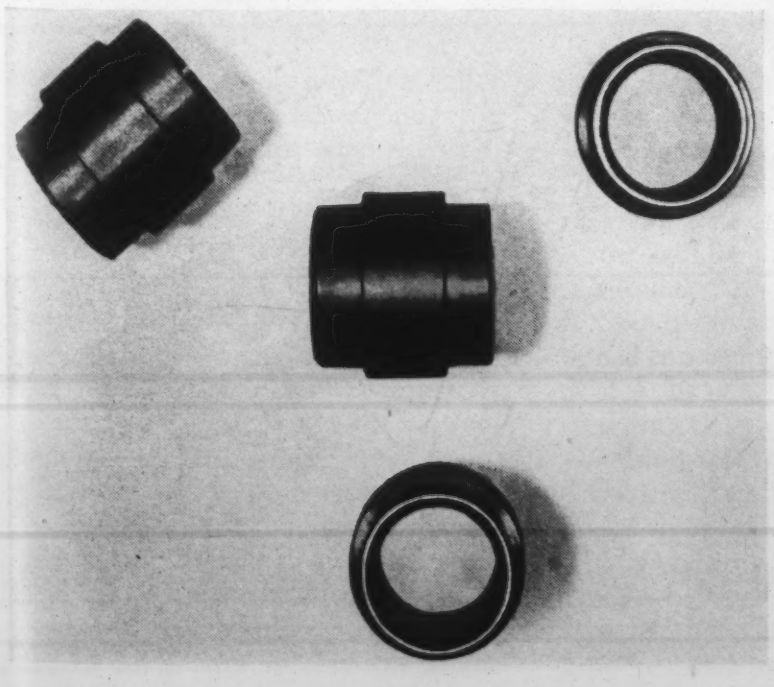
Jones & Laughlin Steel Corp. has improved upon three basic Bessemer steels to produce a group of "E" steels. La Salle Steel Co. and Joseph T. Ryerson & Son, Inc. have both developed open hearth steels with high machinability. Both of the latter steels are leaded. Ledloy, the Ryerson steel, is similar to AISI B1113 in composition, while La-Led, the La Salle steel, has no comparable AISI or SAE analysis.

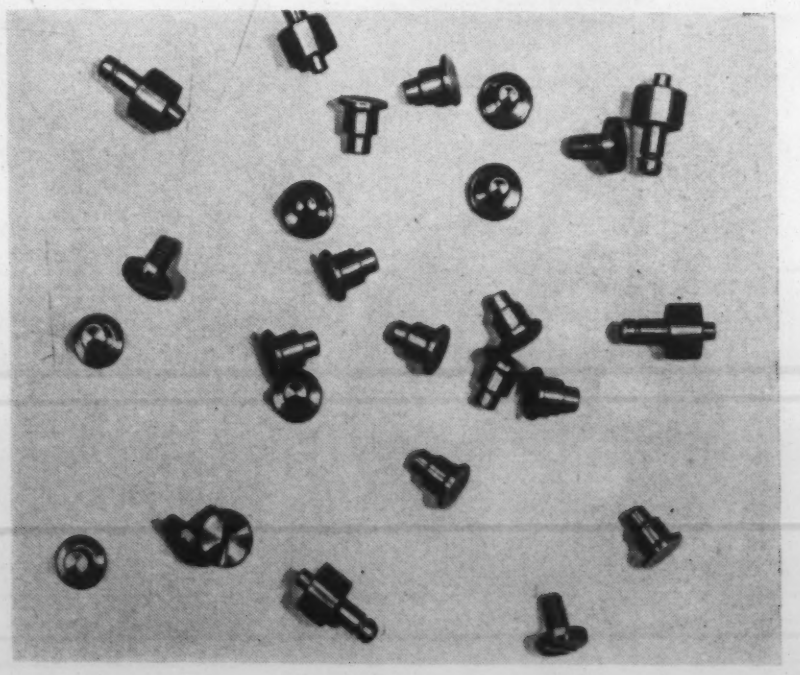
Bessemer Steels

An increase in machinability of at least 25% over comparable grades of old-type Bessemer steels has been attained by Jones & Laughlin in three E steels which have been made available after five years of testing. The new steels compare with B1111, B1112 and B1113 in physical properties. The same treatments can be applied to the E steels as to the standard Bessemer steels. The E steels are said to provide better finish at the speeds. Tool life in cutting E steels has been improved by as much as 200% over steels formerly used.

In developing the new steels, Jones & Laughlin has worked in a direction opposite to that of widely accepted theory. Many believe that machinability is related to brittleness and, therefore, that machinability was achieved by keeping carbon content as high as possible consistent with desired hardness. In the J & L steels, greater machinability is attained with a lower carbon content. Maximum carbon in E steel is 0.06%. The usual carbon content of comparable standard Bessemer screw stock is from

Typical uses for the new "E" group of Bessemer free-machining steels include lubrication fittings, nuts, studs, bolts, washing machine parts and shafts. In producing the parts shown at left, tool life is said to have increased up to 200% with uniformity of finish remaining constant. At right are a group of typical screw machine parts made of the new steels. (Courtesy Jones & Laughlin Steel Corp.)





0.08 to 0.12%.

E steels are being used for nuts, studs, bolts, lubrication fittings, shafts, textile machine parts, switches and many other screw machine products. E steels are available in all standard shapes and sizes. Accompanying illustrations show some applications, together with production data.

Open Hearth B1113

In producing Ledloy, Ryerson took a composition approximating that of AISI B1113, added lead to it, and produced the steel by open hearth methods rather than by the Bessemer process. The lead is said to have no appreciable effect upon physical properties, so Ledloy is quite similar in physicals to B1113 but with somewhat better ductility and an ability to be carburized better.

As yet, no definite machinability standard has been established for Ledloy. In tests it is machined satisfactorily at 325 sfm. as compared to 225 for B1113. In production, reports show it to be machined faster by 30 to 50% than B1113. These rates would indicate that Ledloy machines about twice as fast as B1112, which is the basis for machinability ratings (100%). Tool life in cutting Ledloy is reported as from 50 to 200% longer than in cutting regular Bessemer screw steels.

The lead in Ledloy is added by a special process which results in a distribution so fine that the lead cannot be seen under a microscope. The slight grain refinement that results from the lead addition helps provide the smooth machined surface attained with sharp tools at high speeds.

Ledloy is stocked in cold finished rounds in sizes of ¼ in. and larger. Its cost is somewhat higher than AISI B1113.

Open Hearth Screw Machine Steel

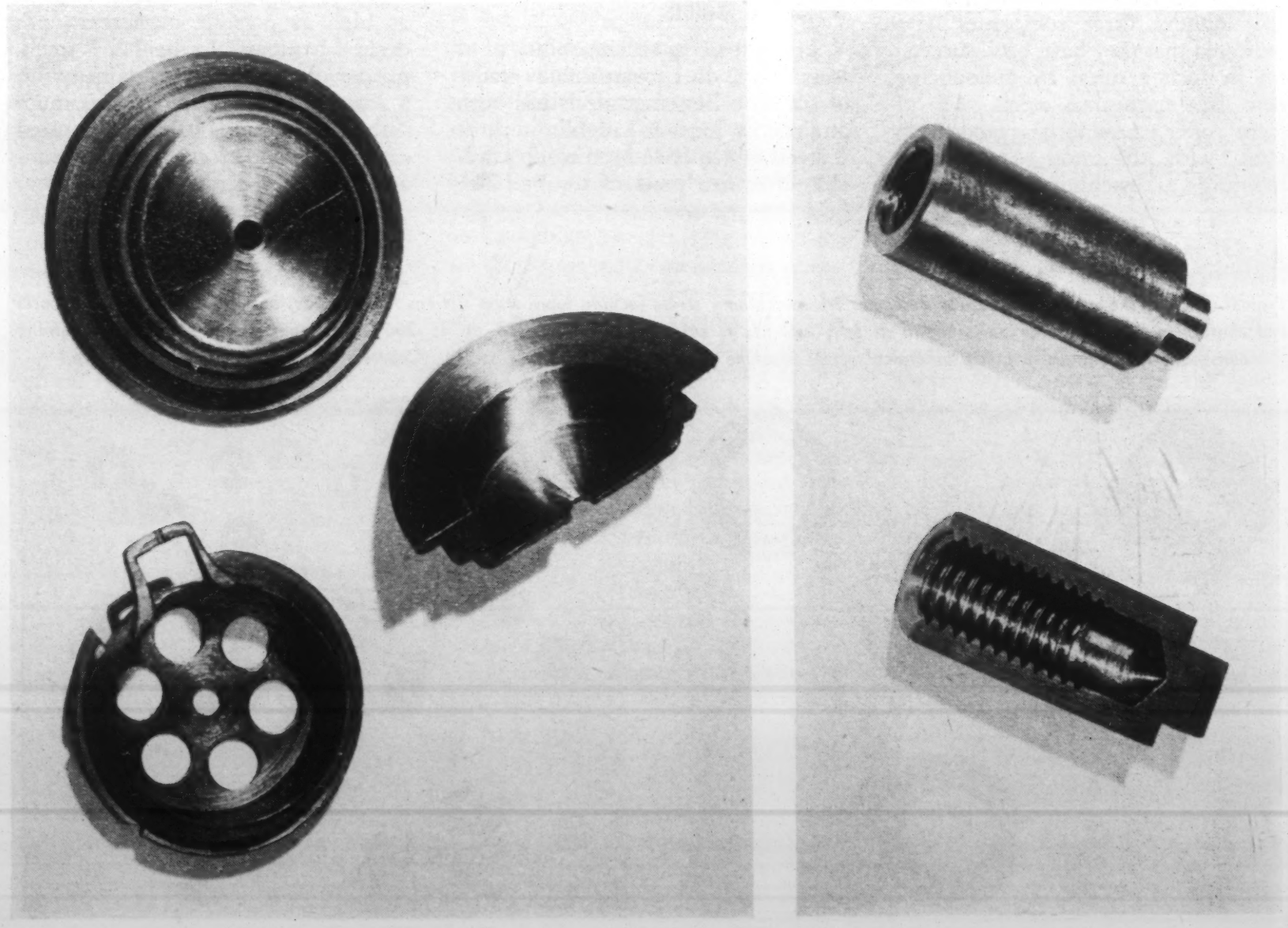
La-Led, produced by La Salle Steel Co., is an open hearth screw machine steel that is rephosphorized, resulfurized and lead bearing. There is no comparable SAE or AISI analysis. Its chemistry conforms essentially to the following analysis: carbon, 0.08 to 0.13; manganese, 0.80 to 1.10; phosphorus, 0.05 to 0.09; sulfur, 0.25 to 0.30; and lead, 0.15 to 0.35%.

Machinability of La-Led is rated as 325 sfm., which is 45% faster than B1113 and about double B1112. Speeds up to 400 sfm. have been reported with high-speed tooling and 600 sfm. with carbides. Tool life and finish are reported as good and dimensional accuracy is readily maintained.

La-Led as cold drawn in the sizes ½ in. to 1½ in. has tensile strength ranging between 70,000 and 80,000 psi., with yield strengths about 10,000 psi. lower. Elongation is reported at 14 to 17% and reduction of area from 45 to 50%.

The new steel is intended primarily for parts requiring extensive machining, but the full range of application has not been determined. Tests are being run currently to learn whether there is a possibility of using the bar stock in place of tubing and stampings.

The parts shown here are typical of those made from one of the new lead bearing screw machining steels, known as La-Led. (Left) A machinery part machined from 1⅝-in. round stock; part was formerly machined from C-1117. (Right) A washing machine insert machined from ⅝-in. round stock, replacing B-1112; production per hour increased 63%. (Courtesy La Salle Steel Co.)



Thick Aluminum and Stainless Steel Joined by New Inert-Gas-Shielded Metal Arc Welding

Development of new equipment which employs consumable metal electrodes further improves this welding process and greatly extends its use in joining difficult-to-weld materials.

by H. R. CLAUSER, Managing Editor, Materials & Methods

• SINCE ITS EARLY development during the war, inert-gas-shielded arc welding has advanced steadily as a dependable method for joining difficult-to-weld materials. With its use uniform high-quality welds have been obtained in such diverse materials as aluminum and its alloys, nickel alloys, copper and copper alloys, magnesium, and stainless steels. During the past year or so another important advance in the process has been made, which extends its use to welding of heavier thicknesses than heretofore practical and thereby greatly broadens its possible applications.

Briefly, the new development involves the use of a metal electrode. The inert-gas-shielded arc process, as originally developed, uses a virtually non-consumable tungsten electrode. The arc is struck between this electrode and the work piece while either helium or argon gas envelopes the weld zone and prevents oxidation. Depending on the application, filler rod may or may not be fed into the arc much in the same manner as in oxyacetylene welding. While this tungsten arc method has proved successful and will continue to be used for many applications, it is limited largely to relatively thin gage metal. For welding thick sections, where filler metal is required, the tungsten arc method is slow and not too economical.

In addition, problems have been encountered in trying to mechanize it. A major drawback to fully automatic tungsten arc welding has been the inability to accurately control the feed of filler wire in relation to the welding arc. The development by Air Reduction Sales Co., The Linde Air Products Co. and Battelle Memorial Institute of a method and equipment that uses a consumable metal electrode in place of tungsten has now eliminated many of these problems.

Process and Equipment Characteristics

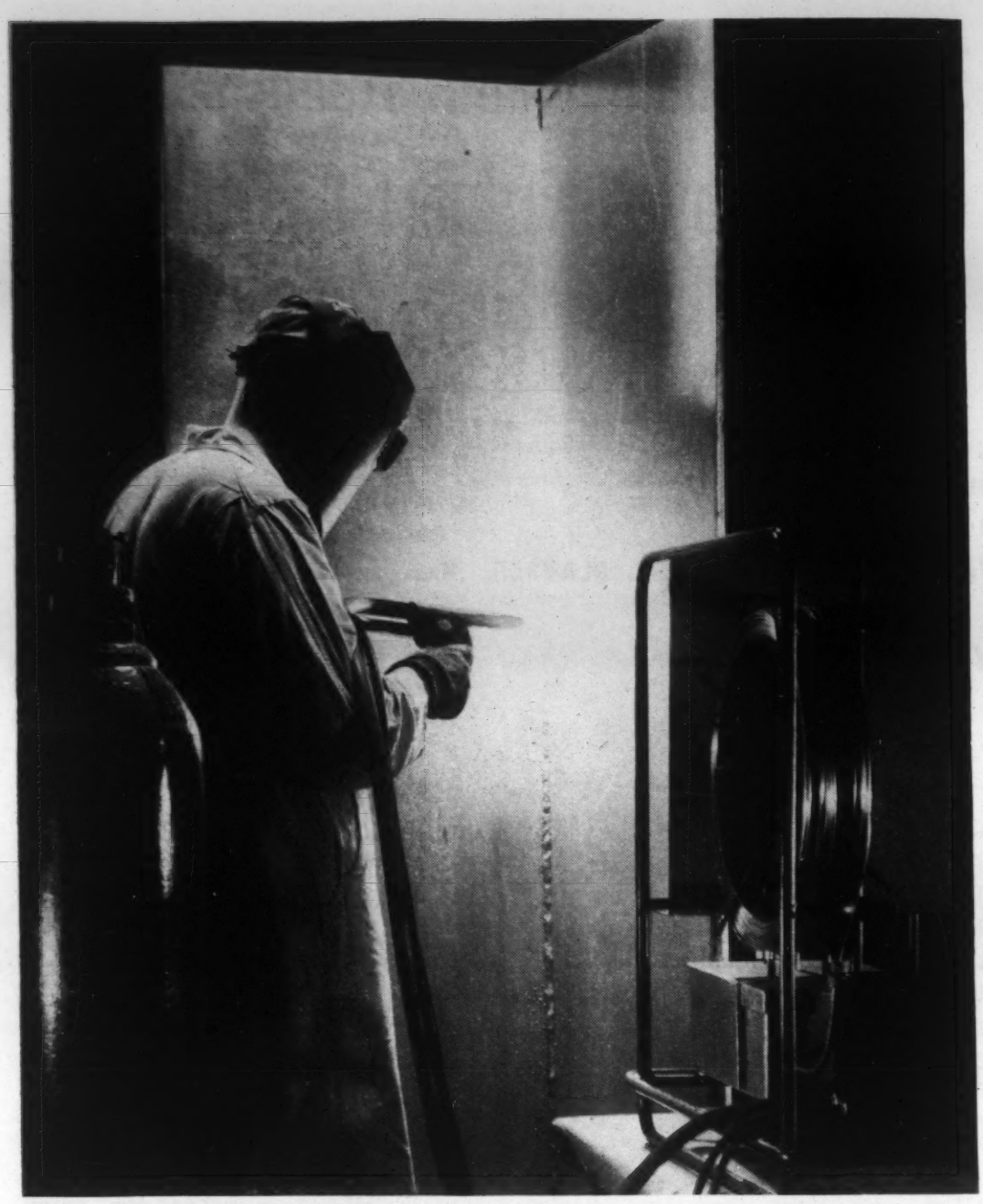
The method involves continuous feeding of bare wire filler metal through the shielding gas. The filler wire, which serves as the electrode, carries the welding current, and the welding arc is maintained between the end of this wire and the work piece. Power for welding can be supplied from a standard direct current welding generator.

Equipment at present is available for semi-automatic hand welding and for fully automatic machine welding. The semi-automatic equipment for manual operation consists of a pistol shaped welding tool as shown in the accompanying photograph. The filler wire and gas are fed through the barrel and nozzle of the gun, and a switch in the handle starts and stops the gas flow and wire feed. The filler wire is drawn off a supply reel and propelled through the gas-filler-wire conductor by means of motor driven feed rolls. These rolls are driven by a variable speed motor through an appropriate speed reducer. Wire feed speed is constant once established. The welding arc, therefore, is controlled by current setting, wire feed speed and the inherent dropping volt-ampere characteristics of the conventional d.c. welding generator. Thus, the arc with the manual tool is self regulating. The hand gun can weld in flat, vertical, and overhead positions using beading or weaving techniques.

In the fully automatic machine units, the welding head is mounted on a carriage (see accompanying photograph) which moves along the work piece as welding proceeds. Or the welding head can be designed to remain stationary while the work moves beneath it. Filler wire is fed from a coil driven by a variable speed electric motor, and its speed is controlled by the welding voltage. Butt, fillet, and lap joints can be welded. At present butt welding is limited to the flat position, and fillet and lap welding to the flat and horizontal positions. Where desirable, weaving techniques can be used.

With both semi- and fully-automatic methods standard joint designs are suitable, and single and multi-pass welds are possible. In the heavier gages, welding is generally performed from both sides of the plate, although some work has been done with single pass welds, using a back-up bar.

In general, gas-shielded metal arc welding cannot be used on metal thickness of less than about 3/16 in. because of the danger of burn-through. Its widest use seems to be on heavier sections where filler metal is required. In commercial practice thicknesses up to around 2 in. have been successfully welded, and it is believed that thicker sections will be welded in production as the applications arise.



Welding aluminum plate in an upright position with the semi-automatic welding gun. (Courtesy Battelle Memorial Institute)

Since the filler wire is the electrode and forms part of the welding circuit, lower welding currents can be used than for comparable welds made with the tungsten-arc method; this results in greater weld deposition efficiency. In general, speeds with gas-shielded-metallic arc welding are 2 to 4 times those with the tungsten arc method, and as a direct result gas consumption is 2 to 4 times lower, which means greater welding economy. In addition, the method has the other advantages of inert-gas-shielded arc welding, which include high weld quality, good appearance of finished welds, no danger of flux entrapment, and no need for flux removal.

Either pure helium or welding grade argon can be used as the shielding gas. Which of the gases to use in any given application is not too clear-cut, for there still exist differences of opinion in the welding field on this matter. However, it is generally agreed that argon is most suitable for welding light gages in all metals, because helium gives a higher voltage drop and, therefore, a higher heat input, and this high input on light sections often causes difficulty in controlling the molten weld metal.

In welding heavy sections this characteristic of high heat input with helium can sometimes be used to advantage in cases where it is difficult to supply sufficient current with a given size filler wire. Also, in machine welding under carefully controlled conditions, there may be the advantage of gaining higher deposition rates. In such cases, although the rate of consumption of helium is greater than argon, the difference in total gas consumption may be quite small because of the faster welding speeds with helium. However, in general, less argon than helium is consumed for a given amount of welding and, therefore, cost of gas is usually less.

As can be seen from above, both gases have some advantages and disadvantages, and the decision as to which gas to use depends on the particular circumstances involved in each application. Work has been done on using mixtures of helium and argon, and in some cases has proved successful.

Aluminum

Inert-gas-shielded metal arc welding can be applied to all the weldable aluminum alloys, including 2S, 3S, 52S and 61S. The fully automatic method is being used at present in the fabrication of tank cars and pressure vessels made of 2S and 3S alloys. These vessels are manufactured to meet the pressure vessel code requirements (ASME U-68) and must therefore have X-ray sound welds. The aluminum plate thickness in the tank cars ranges from ⅝ to 1¼ in. In another case pressure vessels with 1½-in. thick walls of 2S for low temperature service are being completely welded by this process.

Either commercially pure aluminum (2S) or 43S alloy wire, which contains 5% silicon, is used as filler metal. For welding 2S and 3S, or where optimum corrosion resistance is required, 2S wire is used. However, where corrosion resistance is not a critical factor, 43S is often satisfactory. The filler metal wire is available in the following sizes—1/16, 5/64, and 3/32- and ⅛-in. dia.

Aluminum alloys welded with these filler metals show weld strengths at least equivalent to the base metal strength in the annealed condition. This is shown by results of transverse tensile tests on specimens taken from plates welded with the semi-automatic welding gun using helium gas. A 1-in. plate of 3S alloy welded with 2S filler metal gave a transverse tensile strength of 16,030 psi. A ¾-in. 2S alloy plate welded with 2S filler metal tested 13,100 psi. Tests run on 61S-T6 alloy welded with 43S wire had a transverse tensile strength of 24,000 to 31,000 psi.

Tests of 0.505-in. all-weld specimens made with the semi-automatic gun and helium gas also showed excellent results. These are listed below:

Weld Metal	Ultimate Tensile Strength, Psi.	Elongation in 2 In., %	Reduction in Area, %
2S	17,900	25.5	35.9
43S	22,450	8.4	8.6

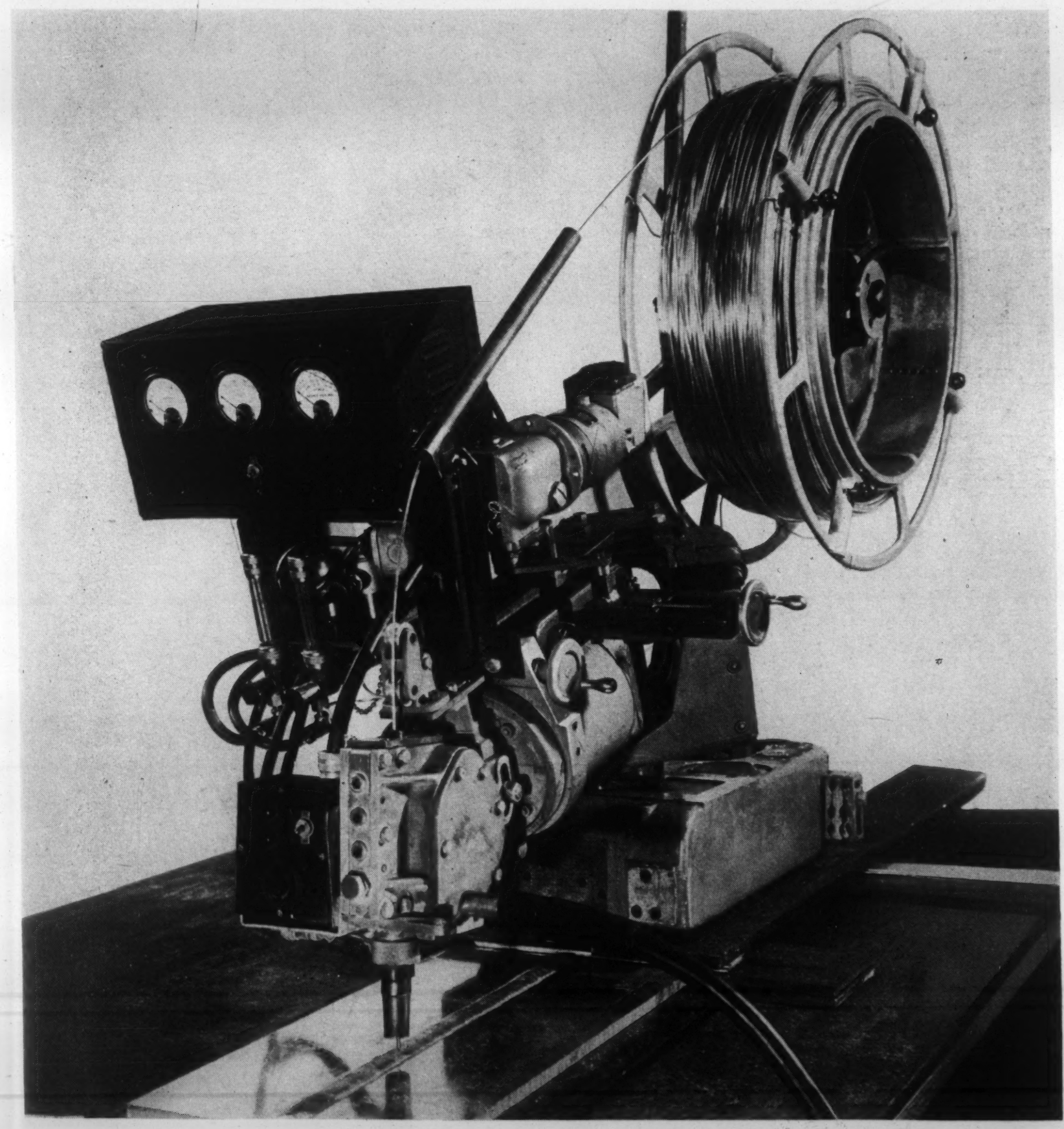
Tests of 0.505-in. all-weld metal specimens made in various aluminum alloy plates in two passes with a fully automatic gas-shielded metal arc welding machine using argon gas show comparable results:

Plate Alloy	Thickness, In.	Ultimate Tensile Strength, Psi.	Elongation in 2 In., %
52S-O	¼	28,000	6
2S-½H	½	14,400	40
61S-T	⅝	30,000	9
61S-T	¾	30,000	11

As is well known, the non-heat treatable aluminum alloy grades (2S and 3S) double or sometimes triple in tensile strength with no appreciable drop in ductility at sub-zero temperatures as low as —320 F. For this reason heavy gage aluminum is a desirable material for equipment operating at sub-zero temperatures; therefore, tests have been conducted to determine the impact strength of the welds at these temperatures. Results of Charpy impact tests on 1-in. 3S alloy plate welded with 2S filler metal showed the following results: at 66 F, 21 to 40 ft.-lb.; at —320 F, 20 to 24 ft.-lb.

Stainless Steels

While the initial work with inert-



A view of a fully automatic machine unit making use of a consumable metal electrode. (Courtesy The Linde Air Products Co.)

gas-shielded metal arc welding was done on aluminum alloys, subsequent work has indicated that high quality welds can be obtained in most of the weldable chromium-nickel stainless steels. At present some commercial welding of types 310, 347 and 316 is being carried on with both the semi-automatic manual and machine units. It is expected that other types will be welded when filler wire is available.

One of the chief advantages claimed for the use of this process on stainless steels is that closer control over the analysis of deposited filler metal is achieved; the filler wire analysis is not changed appreciably when transferred across the arc, as may be the case with coated rods deposited by older metallic arc methods. Thus, since the filler metal analysis is almost identical to the original filler wire, composition of final weld metal is accurately known.

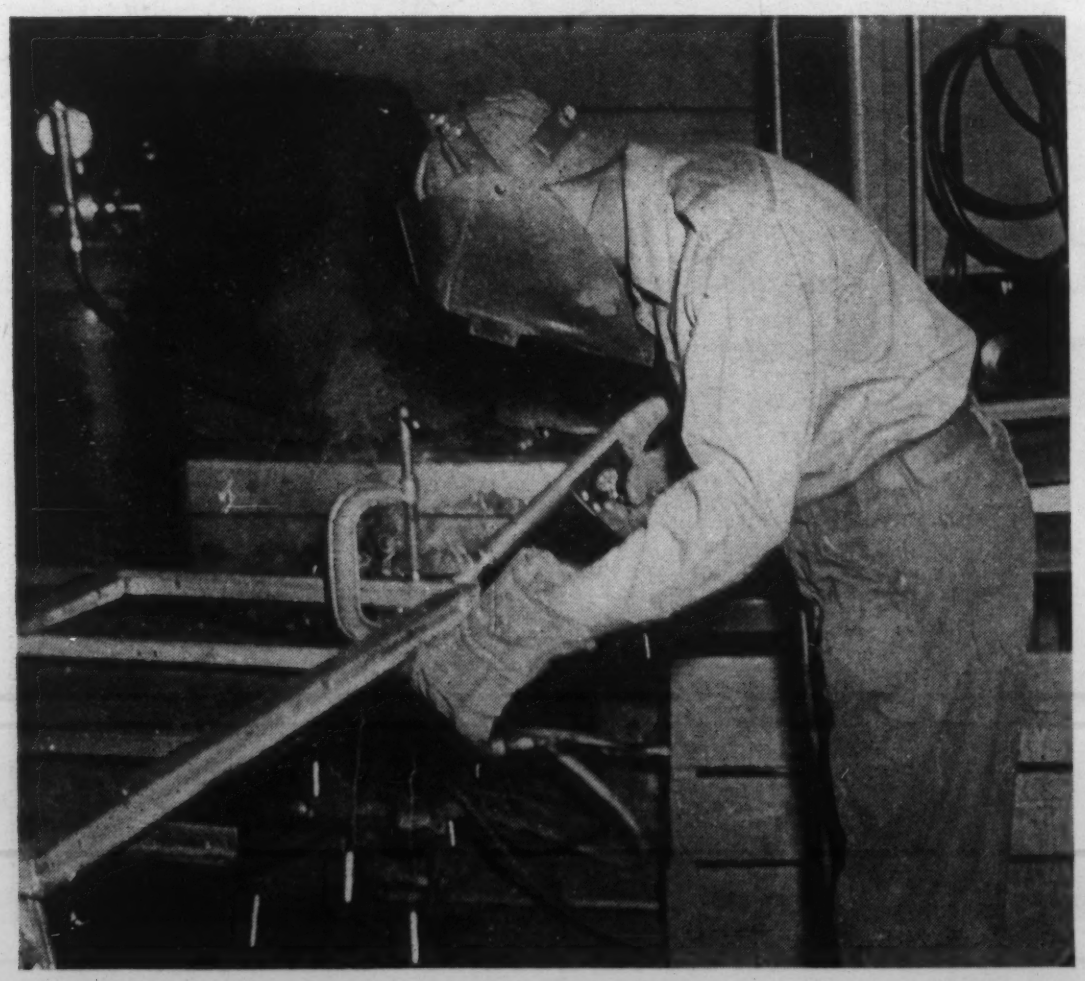
Another advantage that has been pointed out is the rapid deposition rate which results with relatively low heat input, compared to the regular metallic arc methods; this reduces distortion and heat effects in base metal. When using 1/16-in. wire in the semi-automatic hand welding gun, deposition rates in the down-hand position of 15 lb. per arc hr. are possible.

Sound welds without porosity and slag inclusions can be obtained, and the mechanical properties of the welded joint are comparable to those by other methods. The finished weld surface is dull, but it can be ground, buffed and polished to any desired finish as easily as welds made by other methods. Other advantages include: no flux cleaning problem; less welding fumes; and less waste from stub ends of electrodes.

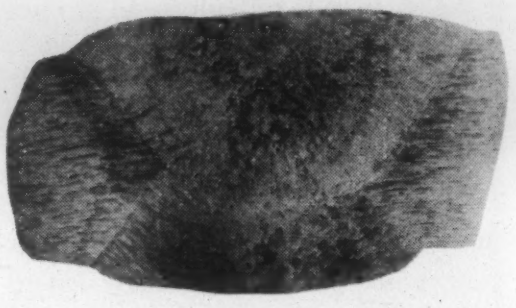
While the process shows considerable promise in the welding of stainless steels, there exists at present some difference of opinion in the field as to its place in relation to regular metallic arc and submerged arc welding. The older methods have proved quite satisfactory in many applications. Although no cost figures are available, it is generally believed that gas-shielded metal arc welding costs more on stainless than the older methods because of the cost of the shielding gas.

Gas-shielded metal arc welding is also applicable to practically all other commonly welded nonferrous metals such as silicon bronze, aluminum bronze, copper, and nickel alloys. It is being used commercially on these materials, and has been found to be particularly suitable for overlaying aluminum bronze. It has also been used successfully on magnesium.

The welding gun being used to weld ¼-in. hinges to ⅛-in. aluminum window frames. (Courtesy Air Reduction Sales Co.)

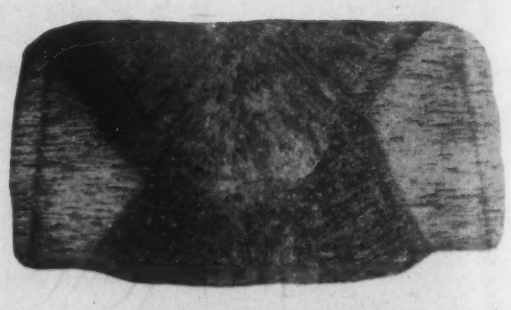


Etched cross sections (2X) of inert-gas-shielded metal arc welds on ¾-in. 61ST aluminum with No. 43 alloy filler rod. (Courtesy The Linde Air Products Co.)



4 Ipm Welding Speed
330 Amp. Welding Current
7.7 Lb. per Hr. of ⅛-In. Dia.

6 Ipm Welding Speed
350 Amp. Welding Current
8.2 Lb. per Hr. of ⅛-In. Dia.



500 F Preheat
8 to 10 Ipm Welding Speed
330 Amp. Welding Current
7.7 Lb. per Hr. of ⅛-In. Dia.

Edge Preparation on All: 60-Deg. Vee, ⅜-In. Nose (1st Side) "U" Backchip, ⅜-In. Deep (2nd Side)

New Vinyl Plastic Has Improved Heat Resistance

by **KENNETH ROSE,** Associate Editor, Materials & Methods

This high molecular weight resin has good heat and light stability, is easily molded and extruded, and can be used as a surface coating.

• A NEW VINYL CHLORIDE polymer with interesting properties has been introduced recently by the Chemicals Division of Glenn L. Martin Co. It is a high-molecular-weight material, with heat and light stability better than those of most materials of this composition.

Large scale production of this resin has now begun in a new plant at Painesville, Ohio, and will be offered to the industry under the trade name Marvinol VR-10. Only the basic resin, without plasticizer or other ingredients of the completed plastic, is produced by the Martin Company. The company does no formulating, but buys from its customers even those finished plastics that it uses itself in its aircraft division. The material is supplied as a fine powder, of which 100% will pass through a 100-mesh screen. It is nonhygroscopic.

The resin can be compounded in one stage on a roller mill or in a Banbury mill. Greater uniformity is possible, however, when two-stage compounding and mixing are used, with a premixing followed by a fluxing, the fluxing making use of elevated temperatures. Premixing can be done wet or dry, depending upon the equipment available and the plasticizers used. Fluxing will require temperatures of about 320 to 380 F if the stock has been properly mixed. The compounded plastic is then granulated, usually on a chopper handling slab stock or filaments.

Aircraft applications of the new plastic include cable coverings and coverings for static dissipators.

Properties and Characteristics

Some of the properties of the resin are given in the following table:

Color	White
Specific gravity	1.4
Apparent density, gm. per c.c. (powder)	0.37 to 0.40
Resistance to water	Excellent
Chemical resistance	Resists dilute acids and alkalies
Flammability	Will not support combustion

The vinyl plastic can be molded and extruded, or can be formed into films as a surface coating or as an unsupported film. Injection molding is done at temperatures of from 300 to 360 F, depending upon the formulation, and the pressure will be 15,000 to 30,000 psi.

Extruding is best done at about 340 to 375 F, or sometimes higher. A typical extrusion application is medical tubing used in blood transfusion and intravenous-feeding equipment for hospitals. The major steps in producing this tubing are: weighing and mechanical blendings of the resin with plasticizer, stabilizer and other ingredients called for in the formulation; further dispersion of the compound in a mixing mill at elevated temperatures to form plastic strips; solidification of the strips by cooling, and grinding to form granules; feeding of the granular material to the extruder from which it emerges as tubing; and conveyor-cooling of the tubing as it flows out to be reeled up. Advantages of the new vinyl resin in this application from the fabricator's viewpoint include the achievement of more compact masses and less dust, larger size batches, and faster extrusion speeds. Heat stability is another advantage, and in this formulation, it stands up well under temperatures around 350 F in the processing cycles.

Paper or cloth can be coated with the plastic, or it can be prepared as a free and unsupported film by several methods, including calendering, casting and spreading. When calendering the plastic to a flexible sheet, the stock is usually fed hot to the calender rolls, and worked at 310 to 365 F, or higher when possible. The material can be calendered onto paper or cloth, first preheating the base material to the approximate temperature of the plastic. Film casting is usually done from a dispersion in volatile, nonaqueous liquids, where the thickness of the film can be controlled to some degree by the dilution of the dispersion. It is sometimes possible to omit blending and milling operations when casting films. Coating is sometimes done by applying these dispersions to a base material, using rollers or knife spreaders. A paste can be made by dispersing the plastic in a plasticizer. A diluent added to this will produce a dispersion of lower viscosity suitable for coating or casting. A fusion step is generally used to consolidate the plastic after coating, and this can be done at temperatures from about 250 to 400 F.

By a simple assembly operation, electrical aircraft cables are inserted in plastic conduit.

The improved heat resistance of the resin, due to its high molecular weight, has already been mentioned. This resistance to deterioration at elevated temperatures carries over into the compounded plastics, the degree of improvement depending upon the type of plasticizer used. A formulation plasticized sufficiently to be used as cable covering for electrical conductors is marketed by Electrical Insulation Corp., with the ability to withstand continuous exposure to 220 F. Another composition with unusual elevated-temperature properties is made as a tubing.

Underwriters' Laboratories have recognized these electrical materials. Standard aging tests have shown that tubing from this resin retains its elongation and tensile strength properties above the marginal requirements. Its resistance to oil, and the stability of such sleeving at elevated temperatures make it suitable as insulation for protecting transformer leads and other such conductors.

Increased strength is another feature that follows from the higher molecular weight. A plastics liner for a portable swimming tank 32 ft. by 68 ft. is one of the products using this property. Water absorption is low—about 0.5%. The material is also finding use in a tough sheet that goes into the upholstery field, where non-flammability is likewise of importance. Columbus Coated Fabrics Corp. reports that the heat stability of the material is a two-fold advantage in that it permits working the material during its milling and blending stages at a higher temperature than is customary, thus speeding the process.

Aircraft applications include electrical wire and cable coverings, mechanical tubing, and coverings for static dissipators. Other items are molded toys, automobile upholstery, shower curtains, shoes, coated decorative papers, and food packaging materials.

Nonferrous Metals Given High Finish by New Chemical Polishing Process

by T. C. DU MOND, Editor, Materials & Methods

This new low-cost acid dip is non-etching and promises to find wide use, especially for polishing intricately shaped parts.

• A NEW, SIMPLE and fast method of polishing metal surfaces has recently been developed by Battelle Memorial Institute, Columbus, Ohio. The process, called chemical polishing, essentially consists of dipping the parts to be polished into a chemical solution; the resulting reaction produces a highly lustrous metal surface. The method is applicable to a variety of metals and alloys, and although not a cure-all, it promises to find wide use, especially for intricate shapes that are difficult and costly or impossible to do by conventional polishing and buffing methods.

The need for a simple dip process for economically producing polished surfaces comparable to those obtained by mechanical methods and by electrolytic polishing has long been recognized. Bright dipping has found use in a number of applications, but its use as a means of final polishing has generally been limited because of its etching action; its inability to provide an even highly reflective surface; and, because bright dips are usually tricky to control. While this new chemical polishing process is an acid dip process, like bright dipping, the bath has a true polishing action and does not pit or etch the surface. Control is simple because neither time nor temperature is critical. The resulting polished surface often requires no additional operations and, where desired, is suitable for subsequent plating.

Description of Process

The solutions used for chemical polishing are essentially oxidizing acid baths composed principally of nitric, acetic and phosphoric acids. Three basic solution compositions have been developed to handle the metals thus far worked with. However, the differences in composition are minor and merely consist of small additions of certain chemicals.

The baths operate at temperatures ranging from room temperature to around 225 F, depending on the metal being treated and time of immersion. In general, the action of bath becomes slower as temperature decreases for a given metal. The bath is usually heated to the desired operating temperature before dipping of the parts is begun. Once in processing of parts through the bath has started, continued heating might or might not be necessary. In some cases the heat of the reaction might be sufficient to keep the bath at the optimum operating temperature.

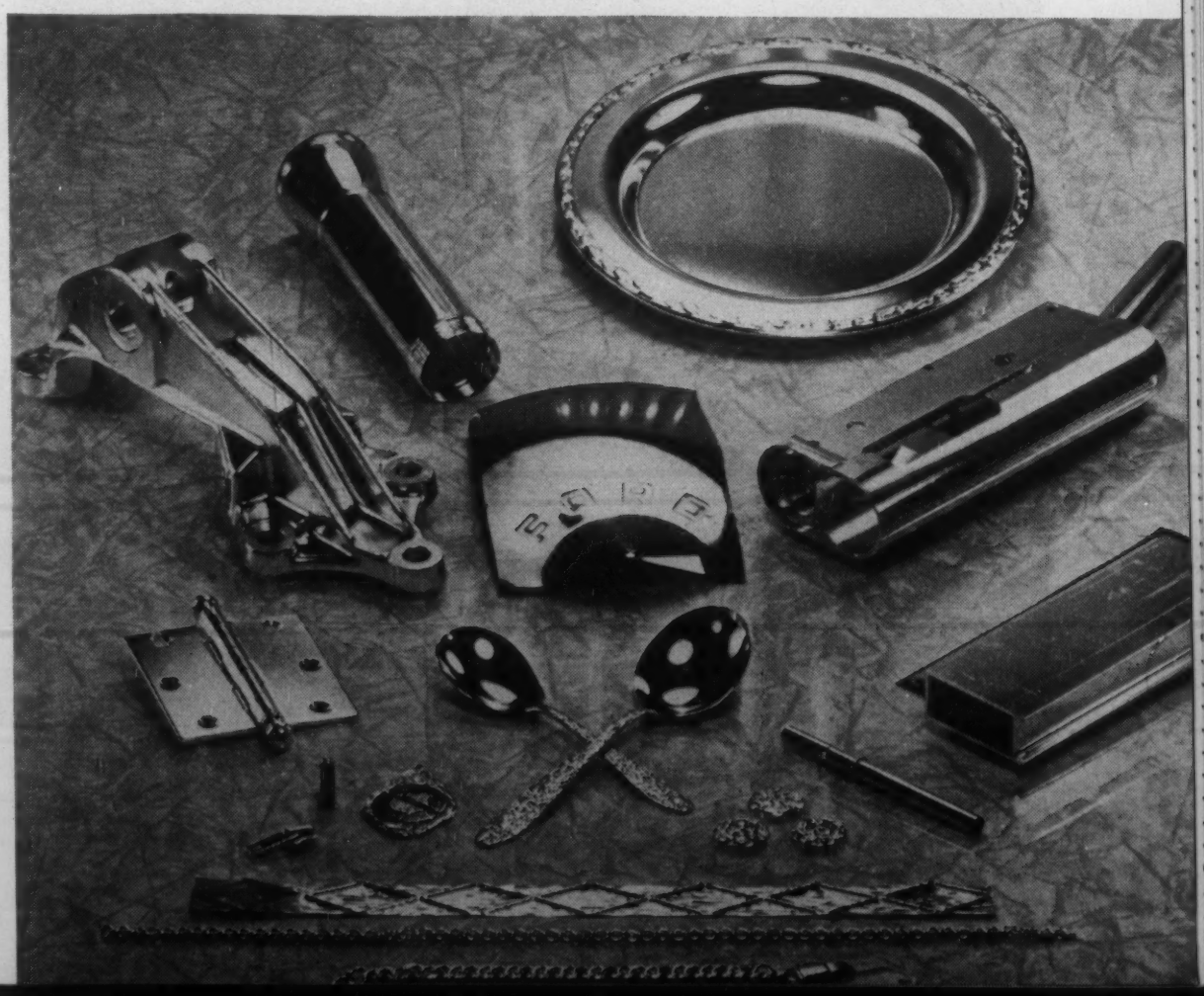
The time of immersion is not as critical as with most conventional acid dips. Immersion periods vary from about 30 sec. to 10 min., depending on the metal, the condition of the initial surface, the final finish desired, and the bath temperature.

Below are listed some typical bath temperatures and times for polishing several common materials:

	Temp. F	*Time*
Brass	130-150	2- 5 min.
Nickel	160-190	1-10 min.
Aluminum	205-220	1- 4 min.

Equipment required for this polishing process is quite simple, the main items being tanks, work handling equipment, and a means of heating. The tank or tank lining can be constructed of stainless steel, Duriron, glass, ceramics, or any other material that will resist the action of hot nitric acid. The bath can be heated by any of the conventional internal or external methods. How-

Fig. 1—Typical parts polished by process range from brass buttons to aluminum forgings.



ever, steam exhaust methods cannot be used because the condensed steam would dilute the bath. Portions of the internal heating devices that come in contact with the bath must, of course, be made of a material that is not affected by the bath. Work handling equipment consists of wire, wire baskets, racks, or similar devices, made of any nitric acid resistant material.

The principal steps in the chemical polishing process are: (1) preclean, (2) dip in bath, (3) rinse, and (4) dry. The quality of the final polished surface depends largely on the quality and condition of the surface to be polished. The work should be descaled, and vapor degreasing to remove foreign matter, such as grease, oil, drawing compounds, dirt, finger marks, etc., is recommended. Solder flux, if any, should be removed.

After cleaning, the parts are immersed for a short period into the polishing bath. Agitation of the work, although not mandatory, is preferable. Although in the initial applications the work pieces have been dipped, it is believed that the polishing solution could be sprayed on, or the solution might be used in revolving barrels.

After being removed from the chemical bath, the polished parts are rinsed with hot water either by dipping or spraying, or both. The parts are then dried by any conventional method.

Besides having the advantage of simplicity, chemical polishing is economical. The cost of chemical polishing has been estimated by licensees to be between 3½ to 6¢ per sq. ft. of polished surface. This figure includes chemicals, labor, equipment, overhead and royalty. In practice, it has eliminated from one to four steps in the finishing of some metal products, and has thus cut finishing costs as much as 50%.

Materials That Can Be Polished

Materials that have been successfully polished by the process include copper, nickel and aluminum, and various of their alloys. Fig. 1 shows typical products of the process, which range from brass buttons and chain to aluminum gun and aircraft forgings. In the lower left to the illustration is a brass medal with a colored enamel inlay. A portion of a nickel-plated hubcap and nickel silver spoons are shown in the center. In Fig. 2 are shown a drawn brass hemisphere and a brass thermostat before and after chemical polishing. Following is a list of the metals and alloys that have been polished successfully to date (December, 1949):

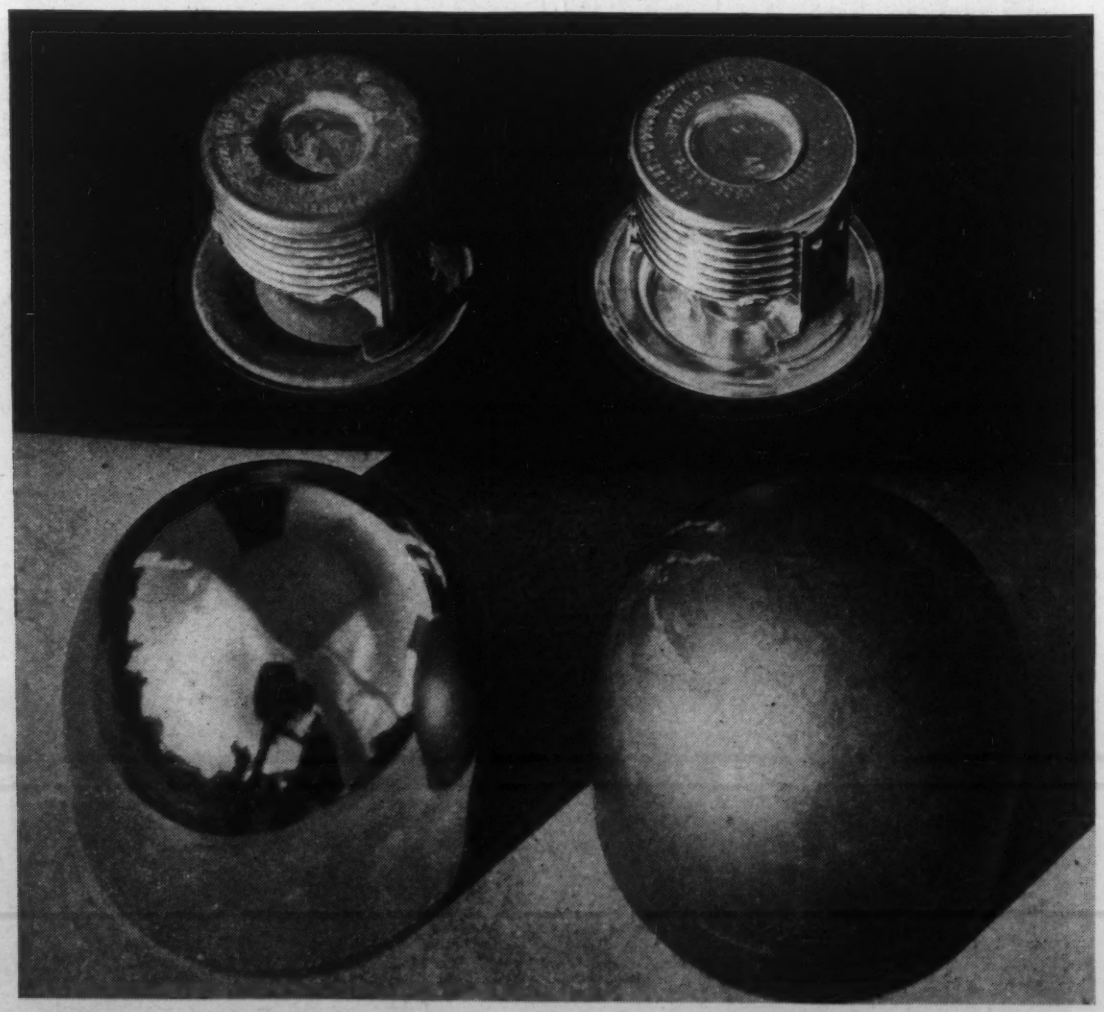
- Yellow brass—sheet stampings
- Commercial brass—sheet stampings
- Logan brass and cartridge brass
- Beryllium copper—sheet and rod —after scale removal
- Die cast brass (lead free)
- Copper—sheet stampings or tubing
- Copper electroplate
- Bronzes—manganese bronzes. Many bronzes do not polish to a bright finish
- Nickel silver—sheet, stampings, silverware, and nickel silver-brass assemblies
- Monel—sheet, rod and tubing
- Nickel with 3% manganese
- Aluminum—
  - 2S sheet and stampings
  - 3S sheet and stampings
  - 4S sheet and stampings
  - 63S extrusions
  - 14S-T forgings
  - 75S-T forgings
  - 24S-T extrusions

The above list is not final, for other materials are continually being tested. To date steels, stainless steels, zinc and zinc-base die castings have not been successfully chemically polished. However, it is believed that by further research suitable bath compositions may be developed to extend the process to other metals and alloys.

Mechanically worked products such as drawn, extruded, stamped and forged articles, in general, polish more readily than castings. Nickel and copper electroplates can be polished by the process, provided that the electroplate is sufficiently thick (no less than 0.0005 in.). As pointed out previously, chemical polishing is particularly suited for intricate shapes, for example, chains, jewelry of all kinds, and parts with deep recesses, holes and undercuts. In other words, any surface that can be wetted can be polished. The largest objects that have been polished to date in the laboratory are aluminum broiler pans for kitchen ranges. The size of the object to be polished is limited only by the size of the equipment available.

The quality and degree of polish obtained by chemical polishing depends largely on the nature and conditions of the base metal surface. In this respect it is similar to electropolishing. Although the chemical polishing bath has definite leveling action and, therefore, tends to even-out surface irregularities and give a uniform overall polish, it will not re-

The automobile thermostat (above right) and the inverted brass cup (below left) have been polished in the chemical bath.



move deep die marks, scratches, and other gross surface flaws such as holes and gouges. Where such marks are shallow they can be removed by lengthening the time in the bath. It is possible to combine chemical polishing also with other methods, such as mechanical buffing or polishing.

The grain size of the metal influences the final appearance that can be obtained. The finer the grain the higher will be the reflectivity of the polished surface. Metal with a grain size within the range 0.010 to 0.025 mm. (plating quality cold-rolled finish) can be supplied by some mills and is satisfactory. Cold worked parts will usually yield more highly reflective surfaces when chemically polished. Metal which shows coarse orange peel when drawn will not have that orange peel removed by chemical polishing. Cast products, with their coarse grain structure, cannot be highly polished by this process. Where joints have been soldered with tin-lead solders, the method will not polish the joint. However, brazed and welded joints have been successfully polished.

The appearance of the polish obtained by chemical polishing is similar to that of electrolytic polishing. In many cases the degree of polish is strictly comparable while in others the reflectivity of chemically polished parts is slightly lower. There is a difference in the appearance of surfaces polished by conventional mechanical methods and by chemical polishing. The polish obtained by mechanical buffing or polishing has a directional cast due to the smearing action of the wheels. Also, the polishing or buffing compounds cause very fine scratches in the surface. With chemical polishing, these very fine scratches and the directional effect are not obtained. In applications where a directional effect in the polished surface is desired, the part can be given a light mechanical polish after the chemical polishing operation.

Although chemical polishing is still too new to have been widely used, a number of commercial applications are already underway and have proved successful. Nickel silver tableware, brass lock hardware, brass picture frames, aluminum forgings and stampings are being polished successfully. Use of the chemical polishing process by one manufacturer eliminated five buffing operations in finishing locks and hasps. A savings of about $65 per 1000 locks and hasps resulted.

Brass plates assembled with cadmium-plated screws have been chemically polished to produce a surface suitable for subsequent copper and nickel plating. Brass rings, which are normally bright dipped and tumbled prior to receiving a flash gold plate, can be chemically polished in a basket to obtain a satisfactory finish in 90 sec. Brass fireplace screen frames, after receiving a 2-min. chemical polishing treatment, can be color-buffed to a mirror plane surface, the treatment eliminating all other wheel polishing operations normally used.

Brass pocket flashlight cases, brass screws, brass compacts, safety pins, nickel laundry tags, nickel-silver clips used in the dental industry, Monel tubing and spinnings, pencil ferrules, and brass license-plate frames are other items that have been treated by the process to acceptable appearance.

A spoon polished in the chemical polishing bath is shown here just before rinsing.

Dual-Purpose Salt Bath Cuts Steel Processing Costs

Descaling and tempering steps are combined to prepare automotive forgings for finishing without sacrifice of quality.

by C. M. CAMPBELL, Metallurgist,
Chevrolet-Saginaw Transmission Div., General Motors Corp.

● PROCESSING COSTS can sometimes be cut by eliminating certain steps in manufacture, or by taking full advantage of the equipment used. A third method that can often lead to reduced costs is the doubling-up or combining of processing functions or operations. While only occasionally can a process or a piece of equipment be given a dual function, such cost-cutting steps are particularly welcomed because they usually involve only a small additional investment, and leave the process as a whole essentially unchanged.

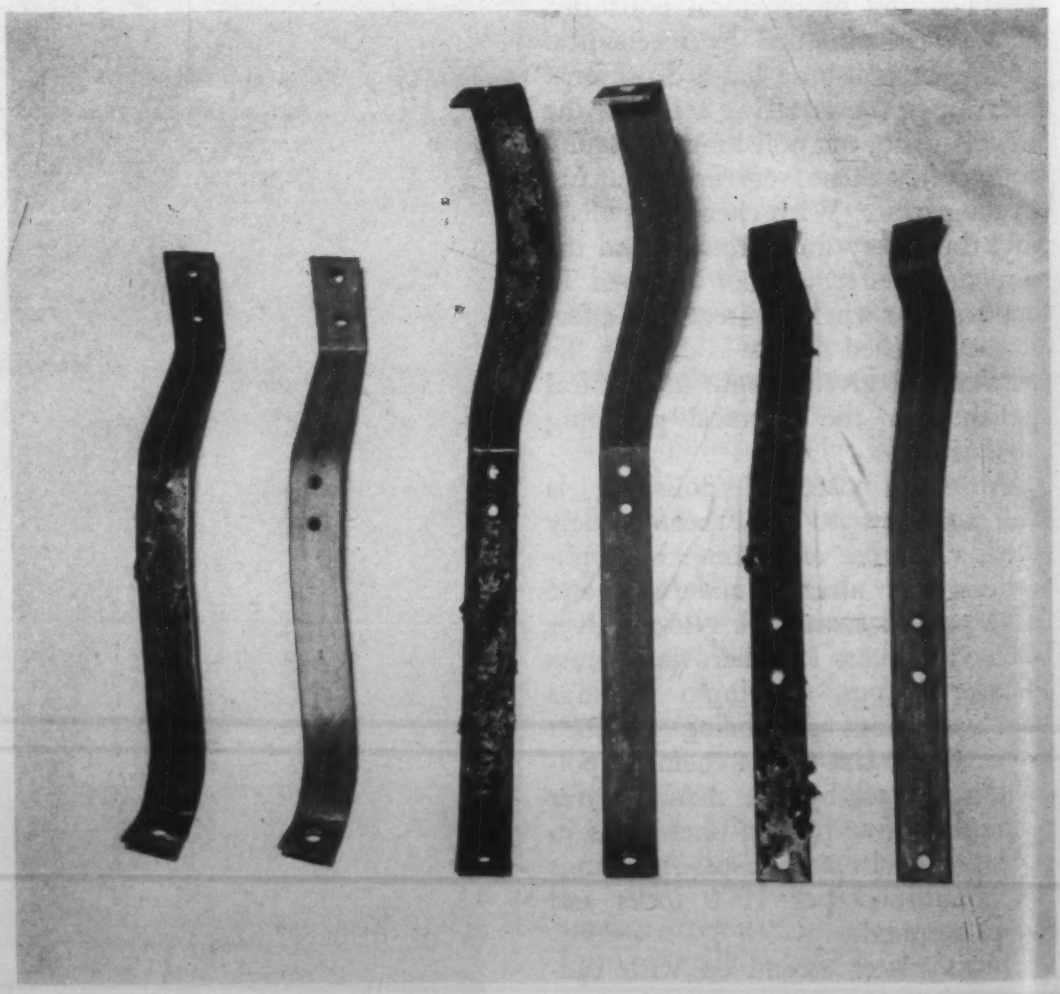
In the Chevrolet-Saginaw Div. of General Motors one of the production lines manufactures bumpers and bumper brackets. These pieces are forged from steel of high enough carbon content to give a good response in heat treating. Specifications call for accurate heat treating, and, in the case of the bumpers, polishing to a high finish as a preliminary to chromium plating. In a study of the operations the possibility of using a salt bath for a dual purpose was considered. The hardened brackets required tempering, and careful descaling was a pre-requisite to good bonderizing before painting. A single salt bath that could descale the formed pieces and at the same time draw back the hardness to the proper degree would effect economies in equipment and in processing costs. After tests had verified proposed methods, this salt bath was put into operation.

Bumper brackets are made from high-carbon steel, SAE 1080, and are heat treated to a final hardness of 321 to 388 Brinell. Brackets are hot formed, and are coated with scale as a result. Brackets are cut from bar stock 7/32 in. thick. Forming consists of edge bending and piercing, and the steel is heated to about 1600 F for processing. The edge bent brackets are again heated to 1600 F and formed in a Gogan Die. After forming, the hot brackets drop into an oil quench. The pieces come from the hardening process with a hardness of 514 to 601 Brinell.

It was here that the change in operations was made. Formerly the brackets had gone into an air furnace to be drawn back in hardness to the required hardness, discharged into water to cool to facilitate immediate handling and to remove by thermal shock some of the scale. The pieces were then hung on a conveyor and carried into an acid pickle to remove the remainder of the scale. From here the pieces were taken to assembly, where they were riveted together, and the assembly then conveyed through the paint and drying oven.

In the present sequence of operations, the hardened pieces are taken through a bath containing a cleaning compound applied with pressure sprays. Loose scale is removed here.

Bumper bracket parts before and after combined tempering and descaling treatment in salt bath.



The work then goes into a dryer at about 200 to 250 F, which serves as a mild preheater; this also reduces the load on the salt bath. Immediately after leaving the preheater and dryer the pieces go into the salt bath.

The salt bath operates at 1050 F, and contains an alkaline descaling salt sold under the trade name of Virgo Salt. The equipment in use at Chevrolet-Saginaw is a unit operating on the Ajax-Hultgren immersed electrode principle manufactured by Ajax Electric Co. It draws about 600 kw., and handles about 8500 lb. of steel per hr. The welded steel pot contains a bath 27 ft. long, 38 in. wide and 42 in. deep. The work is carried into the furnace on a monorail conveyor, fitted with hooks of Monel metal. The hooks will hold from 30 to 70 pieces each. Use of Monel metal permits the hooks to be run through both acid and caustic baths or sprays.

Combined descaling and drawing in the salt bath requires 4½ min. total time in the bath. Hardness is drawn back to the required 321 to 388 Brinell. Adhering scale is loosened in the bath and is knocked off, partly by thermal shock, in the cold water rinse that follows. The cold water is sprayed on to the work through high pressure nozzles.

A pickle in hot muriatic acid is the next step. The acid bath is held at about 160 F. Muriatic acid is used in the amount of 20 oz. of acid to the gallon of pickle liquor. In this acid dip the reduced scale is dissolved, disposing of the last of the surface contamination. The work is then rinsed free of the acid with hot water, and a hot soluble oil rinse completes the operations in this series. Acid is heated with live steam. Condensation of steam causes steady overflow of acid solution. Acid solution overflow reacts with alkali rinse water, neutralizing each other. The pieces go to assembly, where they are riveted together as with the former procedure.

Some of the advantages of the dual-purpose salt bath as here used are:

1. Considerable saving in direct costs. It has not been possible to work out an accurate cost comparison between the two systems, but the figures available show that the saving is large.

2. Saving in equipment. The air furnace used for tempering and the pickling bath that was used immediately afterward have been eliminated by the new arrangement.

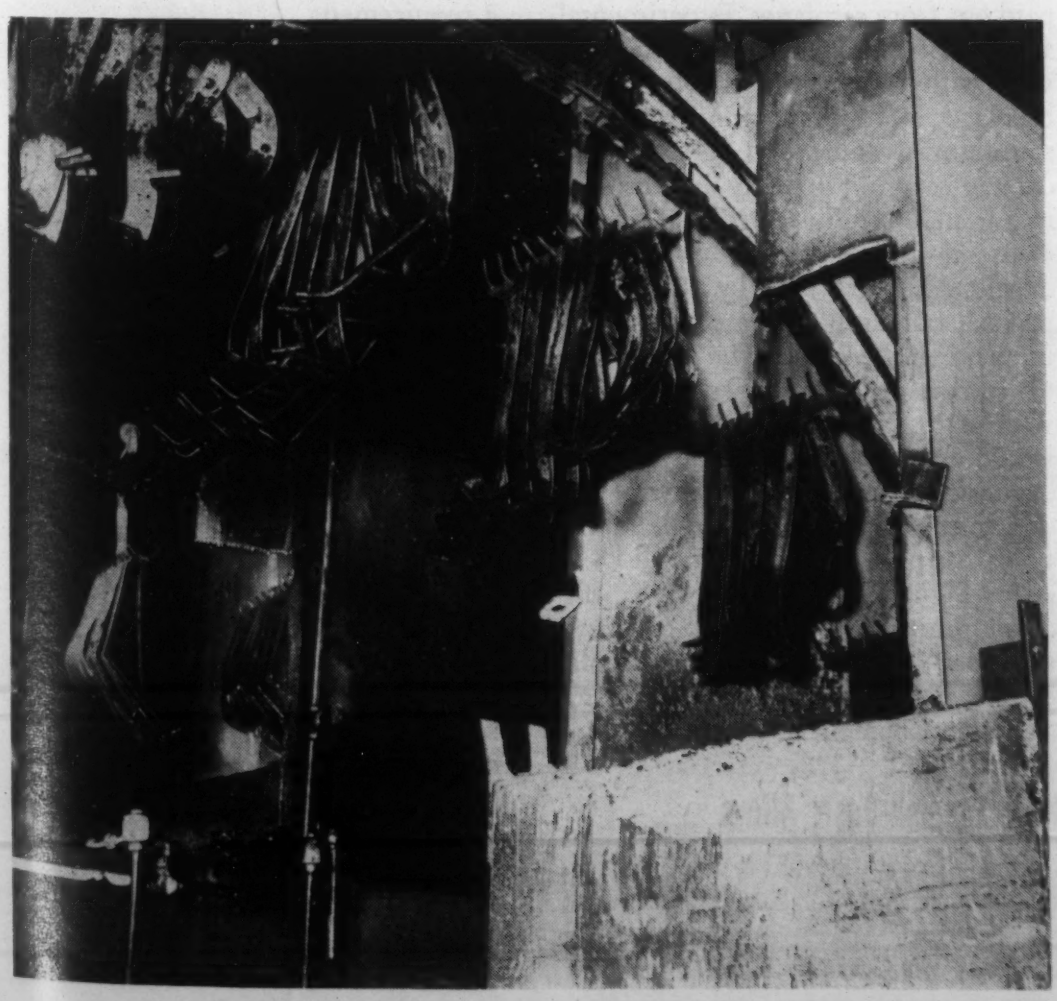
3. Saving in floor space. The present system requires only about half of the floor space needed heretofore for heat treating and cleaning.

In addition, there are savings in time that enter into the cost savings, and a greater uniformity in the hardness of the pieces. The work is completely free of scale, and the final acid pickle is needed only to dissolve the small amount of reduced scale, instead of dissolving all the scale not knocked off by the water jets or by thermal shock. Bonderize on surface is considerably better than that obtained after previous pickle.

Control of temperature is not difficult, and heat transfer from the molten salt to the steel is rapid. The descaling action of the salt is rapid also, so that the 4½-min. period allowed in the furnace is ample to bring the work up to bath temperature, remove the scale and effect the metallurgical changes necessary to draw back the hardness of the brackets.

Close-up of forgings entering the salt bath.

Here shown is the U-shaped arrangement for tempering and descaling the forgings. Entrance is in foreground and exit in the background.



New Copper-Base Alloys Combine High Strength with High Conductivity

by **WEBSTER HODGE**, Battelle Memorial Institute, and
KENNETH ROSE, Associate Editor, Materials & Methods

Electrical and mechanical properties of these new alloys suit them to uses where high breaking strength, minimum volume, and high current-carrying capacity are required.

● THERE ARE MANY applications in industry for materials that possess good electrical conductivity combined with good mechanical strength. To be considered for use in a broad field involving quantity production, the materials must meet other general industrial requirements, such as moderate cost, good workability, and availability.

One of the first large-tonnage uses for electrical conductors of improved strength came with the long-distance power transmission lines. Copper, the best electrical conductor after silver, is both heavy and of rather low mechanical strength, and it was found that aluminum wire, with higher strength-weight ratio and good conductivity, could do a better job with wide spans of wire. For trolley wires, where the element of abrasion resistance enters the picture, a beryllium-copper alloy is frequently favored. Unfortunately, electrical conductivity usually decreases with any hardening of the metals, so that improvement of strength by heat treatment or by work hardening usually means a loss of electrical conductivity. The lowered conductivity is generally much greater than the gain in strength would make practicable, so that conductors are usually used in the annealed condition.

A wartime need spurred the development of several new high-strength, high-conductivity alloys. Field wire for telephone communications with advanced troops is made with a combination of fine steel and copper strands encased in thin plastic insulation. The steel strands provide the required strength, while the copper strands carry almost all of the electrical impulses. This wire is laid by men, often under enemy fire, or is paid out from airplanes. Experimental attempts have been made to lay the wire with rocket projectiles. A high breaking strength combined with a minimum volume and the required current-carrying capacity are absolute requirements. Under tropical conditions, a severe corrosion problem developed, aggravated by the closely packed, but unlike wire strands used in making the cable. The possibility of increasing the efficiency of this wire by producing a material that would act as both electrical and mechanical carrier led to the setting up of a research project at Battelle Memorial Institute, sponsored by the U. S. Army Signal Corps, and finally to the development of two series of alloys that met requirements. Patent applications have been made covering these developments.

New Copper-Base Alloys

The alloys that have met requirements are copper-base types, one series using silver as the alloying element, the other using iron. The silver-alloyed compositions are preferable both in electrical, mechanical properties, and in workability, and it is this group that has been processed commercially. The iron-alloyed materials show interesting properties, but are difficult to cast, and still require further development.

While copper and silver were alloyed in a wide range of percentages in the research work, practical interest, for obvious reasons, was centered in the compositions low in silver. The most useful alloys in the silver series, taking cost into consideration, seemed to be in the range of 4 to 7% silver content, and the formulation using 6½% silver, balance copper, was finally fixed upon as offering the greatest advantages at lowest cost. This composition is now being produced for the electrical industry.

Some of the properties of this 6½% silver alloy that will interest the materials engineer are:

(1) High electrical conductivity. The alloy affords a conductivity of 70% of that of standard copper or slightly higher, even when treated to develop high strength.

(2) High tensile strength. When properly processed, the tensile strength is of the order of 160,000 psi. or slightly higher.

(3) Good spring properties. Fatigue and drift in the tempered state are low enough to make the alloy suitable for use as a spring material where electrical conductivity is also a requirement.

(4) Good corrosion resistance. This is of interest in connection with its possibilities both as a spring and as a conductor.

(5) Good ductility. The material has been drawn into wires of 0.001-in. dia. from ¼-in. rods without annealing.

With the copper-silver alloy, the ingots are annealed at about 1370 to 1385 F for 2 hr., quenched in water, cold-reduced to about ¼-in. square bars, annealed again, cold reduced, annealed, and then drawn to desired diameter. About three anneals are required to put the silver completely into solution. Best properties are obtained by an aging treatment at about 750 F for 12 to 15 min. before the final reduction. Either a nitrate salt bath or a hydrogen atmosphere furnace can be used for this aging treatment. The results of aging were shown in some of the original development work, when two lengths of wire drawn from the same rod, one with the aging treatment and the other without, were tested for tensile

strength and electrical conductivity. Results were:

Without Aging Treatment
Tensile Strength: 123,000 psi.
Conductivity:
About 72% std. copper
Aged 12 Min. at 750 F
Tensile Strength: 164,000 psi.
Conductivity:
About 75% std. copper

An even better schedule for making 0.011-in. wire seems to be: Final anneal at about ¼-in. dia. of rod, aging treatment 12 min. at 750 F at 14-gage size, then draw to required size. This simplifies the processing. It is a valuable feature of the alloy that electrical conductivity falls off very little with cold-working, so that strength can be improved without important loss of conductivity.

Slight brittleness developing with severe drawing can be relieved by reheating the finished wire, for example, at 480 F for 2½ min., but this final treatment is usually not necessary. It is accompanied by a slight increase in electrical conductivity, and usually lowers the tensile strength by a small amount.

When the wire is to be processed for highest electrical conductivity with good tensile strength, test results have shown that annealing at 8 gage, drawing to 14 gage, aging for 4 hr. at 710 F, and then drawing 13 B&S gage numbers hard gave a conductivity of 85.3% with a tensile strength of 116,000 psi. When the drawing was carried to 15 numbers hard, conductivity fell to 83.9% and tensile strength rose to 130,000 psi.

The copper-silver alloy has shown excellent uniformity of properties, and laboratory results during the development stage have been reproduced with commercial batches. Commercial casting of the ingots can be helped by the addition of magnesium, preferably in the form of a master alloy with 90% copper, to the extent of about 0.02% magnesium to the molten alloy. The effect of the addition, just before pouring, is to permit the pouring of the ingot to be done in open air rather than under a shielding atmosphere. Nitrogen was used as the atmosphere in the laboratory. With this small amount of magnesium added, the properties of the alloy remain the same as those for the strictly binary alloy.

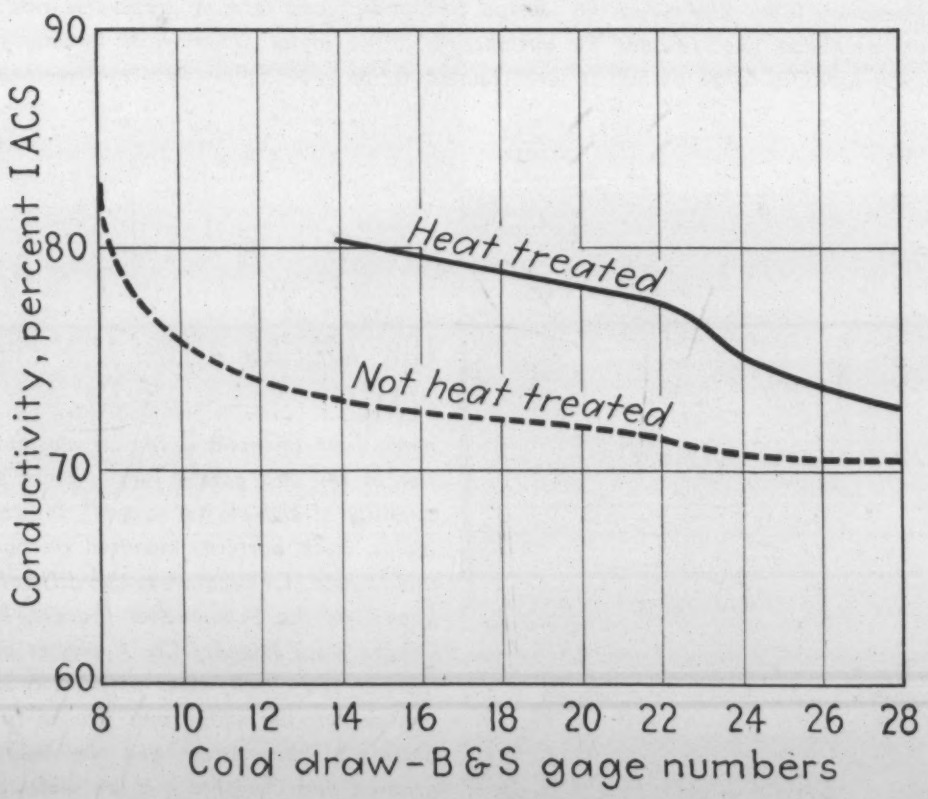
The copper-iron alloys in the range of 10 to 15% iron content were the most interesting in that series, and a 12½% alloy was fixed upon as best. This had a copper equivalent conductivity of about 50% combined with a tensile strength of about 150,000 psi. A major difficulty here was the problem of casting the original ingots, as the copper becomes very fluid at temperatures necessary to get the iron into solution. Magnesium has been used as a deoxidizer, and addition of small amounts of manganese or silicon has been helpful. Heat treatment is necessary to obtain high conductivity. The heat treatment for these copper-iron compositions consists of:

(1) After drawing to about 56% reduction of area, the stock is annealed by heating at about 1650 F for ½ hr., then quenched in water.

(2) The annealed stock is aged at 1200 F for 3 hr., then drawn to about 85% further reduction of area.

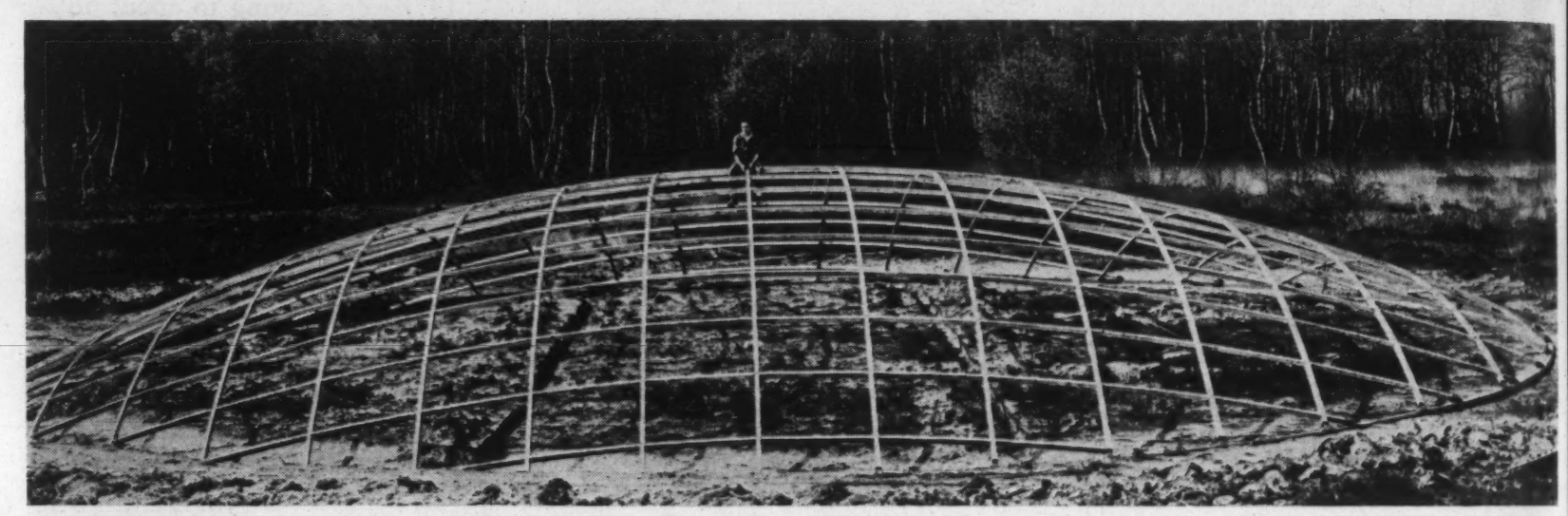
This process can be repeated several times until the wire has been reduced to the required size.

Effect of cold drawing upon conductivity in aged and unaged alloy.

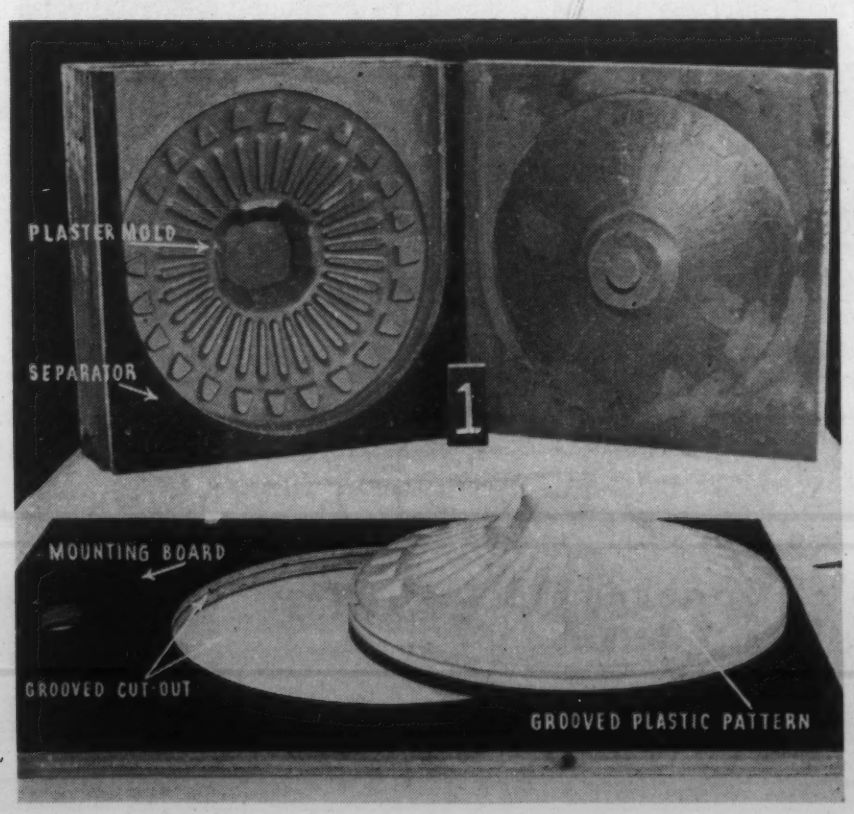


Materials at Work

Here is materials engineering in action . . .
New materials in their intended uses . . .
Older, basic materials in new applications . . .



ALUMINUM ROOF *Intended primarily as a roof for oil or chemical storage tanks, this "self-supporting" aluminum structure is manufactured by the British firm, Aluminum Construction Co. and is claimed to have the same strength as a conventional steel structure. The roof is made of extruded aluminum tubes 2½ in. in dia. curved to a radius and forming transverse ribs at intervals of 5 ft. Aluminum sheet is rivetted to the framework and joints welded for airtightness. Since under symmetrical loading the structure supports itself by tensile and compressive stresses, spans as large as 600 ft. are claimed to be practicable with this method of construction.*



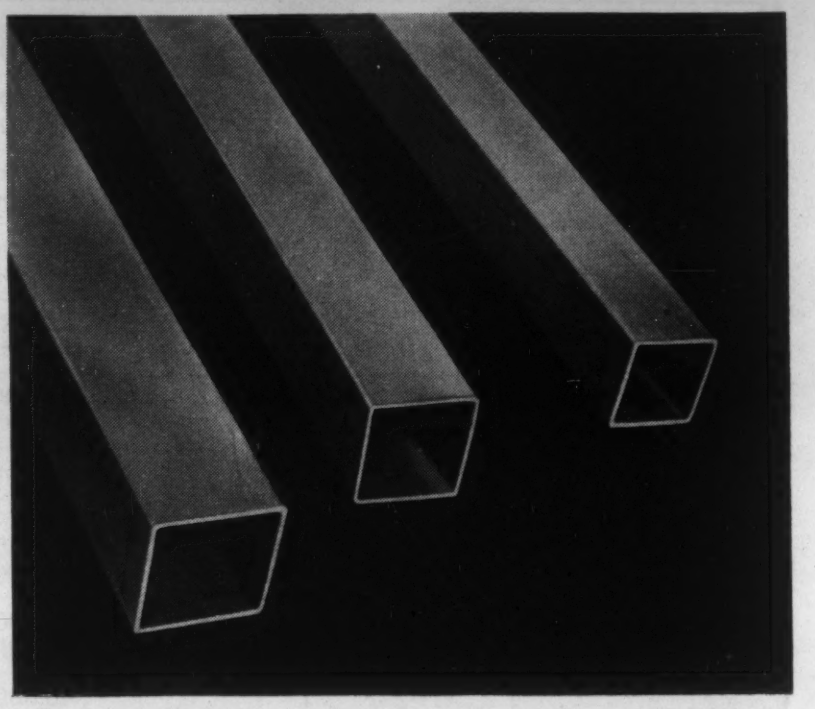
LOW MELTING ALLOY AND PHENOLIC RESIN MATCH-PLATES *In an effort to lower casting costs, plastic patterns made from phenolic resins are customarily used. But the production of full cast plastic plates is not practical because of the low ductility of the plastic suitable for casting of patterns in plaster molds. Such patterns mounted on boards are difficult to match and to hold. To circumvent this difficulty, a novel insertion method, known as the Schumacher Process, has been developed by the Cooper Alloy Foundry Co. A plastic pattern is made in the usual manner and cured, after which it is inserted in a board in which an opening the shape and size of the insert has been cut. The outside of the pattern and the inside of the plate opening are grooved and Cerrobend, a low melting alloy, is used to fill these grooves and lock the pattern to the plate. This technique results in rapid and accurate matching of patterns; eliminates shifting; and facilitates replacing broken patterns on the plate since the locking alloy can be melted out by means of an infra-red lamp. Use of the alloy eliminates all screws or external fastening devices.*

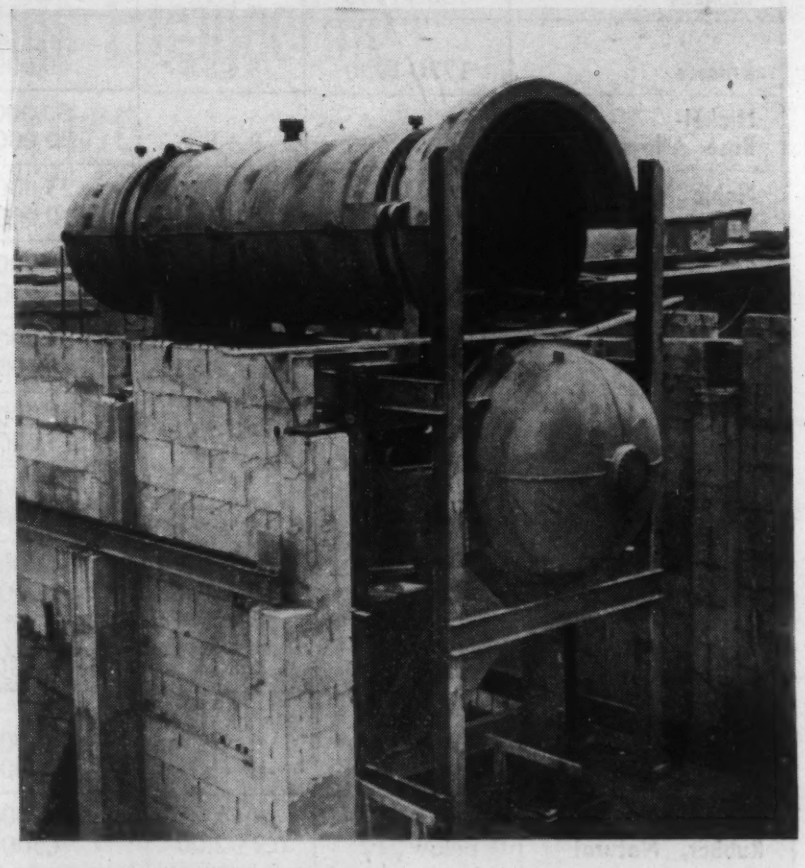
MAGNESIUM SAFETY BLOCKS

Made from especially-alloyed extruded magnesium by Magline, Inc., these blocks are used in metal forming presses as a safeguard to men working within the opening of the press. The blocks combine the advantages of extremely light weight with the correct shapes for best press application. In addition, high unit strength and maximum resistance to shock loads are features which make these blocks an improvement over conventional wood or steel types.

SQUARE TUBING

Designed for use in furniture, automotive, construction and architectural fields for eye-appeal and structural advantages, Electricweld tubing in a variety of unusual shapes has been developed by Jones & Laughlin Steel Corp. Sizes of the new tubing range from 3/8 to 3 in. for the square shapes; 3/8 by 5/8 in. for the rectangular or oval to a maximum that can be made from a 4-in. dia. round size. Irregular shapes to these limits can be made to order.





POLYETHYLENE PACKAGE

Produced by the Auburn Button Works, Inc., this low-cost package is molded in one piece of polyethylene with a self-hinge consisting of a thin connecting web between the lid and the base. The two sections of the box, top and bottom complete with web hinge, are injection molded in a two-cavity mold. The design of the hinge assures long flexing life and the "plastic memory" of the material gives a spring action when the snap-clasp is released. The hinge has been tested through 70,000 openings and closings without failure. In addition, the low specific gravity of the polyethylene eliminates half the ordinary weight of comparable containers.

STEEL PRESSURE CHAMBER

Capable of withstanding pressures up to 1000 psi., this 30-ft. cylindrical chamber is used at the Naval Ordnance Laboratory in tests of submarine equipment under conditions resembling those at considerable ocean depths. The body of the pressure vessel is a shell, or drum, of high-strength steel, 3 5/16 in., thick. This drum, built by Babcock & Wilcox Co., was subjected at the plant to heat treatment for relief of possible welding stresses, X-ray examination, and various other tests. The lowering and raising of the 78,000-lb. door is accomplished by a hydraulic lift actuated by push-button control and automatic relays, which operate the door safety locks and hydraulic system through a pre-set cycle.

CORRECTION

The box appearing at the bottom of this page was inadvertently omitted from page 82 of the **Fabricated Materials and Parts Manual, No. 54** (Dec. 1949). For the sake of clarity, the entire page, as corrected, is being reprinted here.

Materials and Corresponding Forms for Small Parts

Material	Physical Properties				Atmospheric Corrosion Resistance	Forms in Which Commonly Used for Fabricated Parts
	Melting Points, Deg. F	Specific Gravity	Tensile Strength, Psi.	Yield Strength, Psi.		
Low Carbon Steel and Iron	2750-2800	7.8-7.9	50,000-120,000	30,000-90,000	Fair	1, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18
High Carbon Steels	2600-2750	7.8	100,000-200,000	75,000-175,000	Fair	1, 5, 9, 10, 12, 15, 18
Engineering Alloy Steels	2500-2750	7.8-8.8	80,000-250,000	50,000-210,000	Fair	1, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 18
Tool and Die Steels	2600-2800	7.5-10.0	100,000-250,000	80,000-200,000	Good	1, 5, 6, 15, 18
Tungsten Carbide	Cobalt melts 2700	14-15	125,000-400,000 transverse rupture strength		Good	13, 18
Stainless Steels	2500-2800	7.4-8.0	100,000-220,000	50,000-125,000	Excellent	1, 5, 6, 7, 8, 9, 10, 11, 12, 18
Tinplate	Tin melts 450	8 approx.	50,000-60,000	25,000-30,000	Excellent	10, 11, 13, 15, 18
Iron, Cast and Malleable	2100-2400	7 approx.	25,000-120,000	Up to 60,000	Fair	1, 2, 10, 13, 14, 18
Copper	1980	8.9	23,000-52,000	14,000-50,000	Good	1, 6, 7, 8, 10, 11, 13, 14, 15, 16, 17, 18
Bronzes	1800-1950	7-9	40,000-200,000	20,000-175,000	Good	1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18
Brasses	1720-1950	8.4-8.8	30,000-40,000	15,000-50,000	Good	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18
Nickel-Base Alloys	2200-2600	8.3-8.9	60,000-100,000	30,000-80,000	Excellent	1, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 18
Noble Metals (Inc. Silver)	1750-3600	10-21.5	23,000-150,000	12,000-80,000	Excellent	5, 9, 10, 11, 12, 13, 15, 17, 18
Zinc and Its Alloys	727-785	6.6-7.1	15,000-45,000	10,000-25,000	Good	2, 4, 10, 11, 12, 17, 18
Lead and Its Alloys	300-625	10.5-11.5	2,000-12,000	1,000-10,000	Good	4, 15, 16, 17, 18
Tin Alloys	360-470	7.3-7.8	2,000-15,000	1,300-9,800	Good	4, 11, 15, 18
Aluminum and Its Alloys	940-1225	2.6-2.9	13,000-72,000	5,000-62,000	Good	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18
Magnesium Alloys	815-1200	1.74-1.9	13,000-65,000	3,000-50,000	Fair	1, 2, 4, 6, 7, 8, 13, 15, 16, 17, 18
Silicones	Usable up to 390	1.3-2.3	400-600	—	Excellent	16, 20
Ceramics, Technical	Working temp. below 1832-3112	1.6-4.0	3,000-10,000	—	Excellent	16, 20
Rubber, Natural	Working temp. below 212	0.93-2.00	3,000-4,500	—	Fair	16, 20
Rubber, Synthetic	Soften between 225-300	1.20	1,400-4,550	—	Good	16, 20
Plastics	Working temp. below 475	1.25-2.09	3,000-15,000	—	Excellent	16, 19

Fabricated forms or parts (see last column in table above). The numbers shown in column refer to the following fabricated forms and parts:

1. *Sand Castings*
2. *Permanent Mold Castings*
3. *Plaster Mold Castings*
4. *Die Castings*
5. *Precision Castings*
6. *Drop Forgings*
7. *Press Forgings*
8. *Upset Forgings*
9. *Cold Headed Parts*
10. *Stampings, Formed Parts*
11. *Spinnings*
12. *Screw Machine Parts*
13. *Powder Metal Parts*
14. *Electro-Formed Parts*
15. *Sectioned Tubing*
16. *Cut Extrusions*
17. *Impact Extrusions*
18. *Welded or Brazed Assemblies*
19. *Molded Plastics*
20. *Molded Nonmetallics*

Materials & Methods Manual

This is another in a series of comprehensive articles on engineering materials and their processing. Each is complete in itself. These special sections provide the reader with useful data on characteristics of materials or fabricated parts and on their processing and application

55

Review of Materials Engineering Developments in 1949

by the Editors

The year 1949 saw many improvements in engineering materials and in methods of processing and fabricating them. Here is a concise, up-to-date report on the most significant recent developments in new materials, fabricated forms and parts, finishes and coatings, as well as what is new in heat treating, joining, finishing, machining and forming.

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Introduction

Keeping abreast of all technical developments in the fields of materials and materials engineering could very easily occupy the full time of any engineer; thus we take it upon ourselves each January to review developments of the past 12 months and summarize those which we feel to be of permanent importance.

To the user of materials, 1949 was a strange year. Last January practically any metal you would care to consider was scarce and the prices of most were extremely high. Later all, or nearly all, were readily available and prices of nonferrous metals dropped considerably. As we begin another year there are shortages in some metals, namely steel and copper, caused primarily because of strikes cutting down production of those valuable materials.

Developments which came to the ripening stage during 1949 were chiefly concerned with reducing costs of providing ultimate products or making an improvement in the quality of such products without adding to the purchase price. Trends which were apparent in earlier years were carried forward, such as producing parts to closer tolerances or in such a condition that they require less finishing operations, and the producing of larger parts by means of existing methods. As an example of what we mean by the latter, we can refer to such achievements as the die casting of the entire inner portion of an automobile door in one piece or the molding in plastic of a 35-lb. television cabinet in one operation.

In ferrous metals, nodular irons came in for considerable attention, with progress this past year confined largely to examining where such irons fit and providing safer and simpler means of changing ordinary iron into the highly desirable ductile material. Titanium is making impressive gains in the thoughts of materials engineers, and is, in fact, now being considered for so many things that its sponsors are worrying lest it be widely misapplied, as has been the case with other glamour materials in recent years.

In the field of nonmetallic materials, plastics, of course, have received the most attention, with one interesting development being a plastic which molds readily with low pressures and can be cured at extremely low temperatures. Such a development could well mean that many plants not now doing any molding will consider establishing their own plastics departments, particularly with the low cost of the equipment.

Of interest to those who are concerned with the production of small parts is a new method which contains some of the elements of die casting, forging and coining. Known as the Bacco process, this metal forming method can be used with a variety of materials and will find its greatest use on parts which would normally require considerable machining when produced by other methods.

Probably of most universal interest among finishing developments of the past year is a new chemical polishing process which promises to have an interesting future in polishing nonferrous metals, particularly when those metals are formed into parts that are difficult if not impossible to buff. Of less general interest, but still important, is the fact that powdered metal parts can now be electroplated.

The last few months gave impetus to the development of inert gas-shielded metal arc welding processes for the joining of aluminum and stainless steel. These processes are expected to facilitate greatly the extended use of the metals.

In presenting this review it is our hope that it will serve as a reminder to those who may have forgotten some of the developments of 1949; as a means of quickly catching up on the highlights of some developments you might have missed; and as a permanent record of 1949's achievements in the field of materials engineering.

Irons and Steels

Development in the field of iron and steel during 1949 was well divided among several different materials groups, but most attention was paid steels of the more highly alloyed types and attempts to provide better structures and, consequently, better properties in cast irons.

High Grade Cast Irons

The reference to better cast iron, of course, means those irons variously called ductile cast irons, nodular irons and spheroidal cast irons. All are basically the same, at least in intent, even if there is considerable variance of opinion as to the exact shape the carbon takes after the prescribed treatments.

The ductile irons, for that is really what they are, are not a development of 1949 in a strict manner of speaking. However, the refinement of processes for producing such irons has claimed the attention of innumerable researchers during the year. Actual new developments have come in the additives which produce the spheroidal structure of the carbon in the iron. Tensile strength of many irons of this class exceed 80,000 psi., with elongation on the order of 8 to 9%.

Since this country seems to have decided that magnesium is the best suited additive agent to produce ductile cast irons, research and development has centered about means of making easier the task of adding the magnesium.

One development along these lines is a magnesium-ferrosilicon addition alloy. The alloy is nominally 7 to 10 magnesium, 43% silicon and the remainder iron. This addition agent acts as both an inoculating and nodulizing agent and has the added advantage of reducing magnesium flare.

As to the use of ductile cast iron, there still appears to be some doubt, or at least uncertainty, as to where it will best fit. This situation should be cleared soon, because at least 100 foundries throughout the country are casting ductile irons to varying extents. Large potential applications appear to lie in the automotive and diesel fields and in making agricultural implements, with several other fields under investigation.

Stainless Developments

A low carbon stainless steel is now about to make its debut. The new steel contains a maximum of 0.03% carbon and has the virtue of being resistant to intergranular corrosion. In most respects the new stainless is comparable to those 18:8 stainless steels which have been stabilized with columbium or titanium.

Production of low-carbon stainless required the development of new manufacturing techniques by Carnegie-Illinois Steel Corp. to keep the carbon level at the desired point. The steel has been extensively laboratory tested as well as use tested by fabricators of chromium-nickel stainless steel, particularly for its resistance to intergranular corrosion.

On the basis of established standards, the 18:8 steels containing not more than 0.03% carbon are equal in corrosion resistance to the more highly alloyed steels they are intended to supplant. Welding tests show that the new steels can replace the stabilized for those applications, such as welding, that involve short heating times in the sensitizing temperature range.

Demand for a steel that would provide higher mechanical properties and corrosion resistance than available stainless steels led to the development of a new age-hardenable stainless. Armco 17-4 PH stainless, the new steel, has high strength and hardness, high corrosion resistance, good fabricating characteristics, and hardens at temperatures between 850 and 1000 F. The corrosion resistance is said to approach that of the 18:8 stainless steels and to be superior to standard hardenable grades of stainless.

Hardness values of 40 to 45 Rockwell C with high tensile and yield strengths are obtained by precipitation hardening. Armco 17-4 PH can be hot-forged, machined and welded. The material is available as bar and wire in either the annealed or hardened condition.

Another new stainless which was introduced somewhat more than a year ago in certain wrought forms is now available in sheet and plate. Known as Durimet 20 and Stainless 20, the steel is used extensively in chemical processing equipment. It is highly resistant to the corrosive effects of sulfuric

acid as well as many other substances. Although more expensive than standard stainless steels, No. 20 has outlasted other materials by as much as 100 times in terms of service life. Its mechanical properties are similar to those of 18:8 stainless. Sheet is being produced in gages from 24 to 11 and plate from 3/16 in. up.

Free Machining Steels

During the past year several companies have announced new steels which can be machined at rates much faster than is possible with the standard screw machine stocks.

Jones & Laughlin Steel Corp. have introduced three E steels which are comparable in many ways to the AISI steels B 1111, B 1112 and B 1113. An important exception is that carbon is kept much lower in these steels than in the standard Bessemer screw steels. The E steel which supersedes B 1113 has a machinability index of 170 as compared to 135 for B 1113. The steels are also said to provide better finish, better cold working and cold forming properties and give longer tool life than their predecessors.

Also in the free machining group is La-Led steel, produced by La Salle Steel Co. La-Led is an open hearth steel, thus providing better ductility, and has added to it lead for better machinability. Claims are made that this steel machines anywhere from 40 to 106% better than B 1113, depending upon tools and other conditions. La-Led will carburize readily and can be bent and crimped.

Joseph T. Ryerson & Son, Inc. also has a new free machining steel. Ledloy, as the steel is known, is basically similar to B 1113 except that lead is added to the composition and that it is an open hearth rather than a Bessemer steel. An increase in machinability from 30 to 50% over B 1113 is claimed for Ledloy, along with an increase in tool life, better finish and good ductility. It can be carburized.

Hobbing Steel

Sampson Extra, a new steel for plastic mold cavities and force plugs, is a development of the past year by Carpenter Steel Co. The steel offers excellent hobbing qualities plus good machinability and high core strength.

As oil quenched after case hardening, Sampson Extra gives an average Rockwell C hardness of 64 on the case and 20 in the core with a core tensile strength of 108,000 psi. and core yield strength of 69,000 psi. All properties are slightly higher with a water quench.

It is said for this steel that many intricate mold shapes can be hobbed in one operation, deeper impressions can be pushed with present equipment, and more accurate reproduction of hob design is possible.

Other New Steels

In searching for a simple and inexpensive alloy addition that could be used to prevent coarsening in low-carbon titanium steels, Titanium Alloy Manufacturing Div., National Lead Co., discovered an alloy having exceptionally high hardness and stress-rupture properties after quenching and reheating at high temperatures. The new steel is still in the development stage.

With boron additions of 0.01% or greater, a hardness of 85 Rockwell B can be obtained on quenching the low-carbon titanium steel from 2100 F. For certain compositions, appreciably higher hardnesses were obtained upon tempering at 1100 F. No trace of graphitization was found after 10,000 hr. at that temperature. Stress-rupture tests indicate 1000-hr. life at 1000 F and 50,000 psi.

Allegheny Ludlum Steel Corp. has developed a new ferrous magnetic alloy which has a rectangular hysteresis loop. The alloy contains 50% nickel. The material, known as Detlamax, is finding applications in the field of contact convertors and magnetic amplifiers. The alloy is available in the form of torodially-wound cores in a number of standard sizes.

Cast Alloy Steel

A new alloy steel capable of good engineering performance at temperatures as low as —423 F has been developed by Lebanon Steel Foundry. Lebanon Grade 22, as the steel is known, is an austenitic cast ferrous alloy. It contains 19.5 chromium and 9% nickel.

Grade 22 is being used effectively in the production of steel castings for storage of liquid oxygen. Storage is under high pressures and temperatures approximating —298 F. The alloy steel has also shown good heat resistance in applications involving extremely high operating temperatures, including jet engine components and parts for gas turbines.

Laboratory tests show the tensile strength to be 200,000 psi. at —423 F. There is a corresponding loss of ductility as temperature is lowered, but not in proportion to the increase in tensile strength. The alloy can be welded by gas and electric processes without subsequent heat treatment.

Nonferrous Metals

During 1949 two comparatively new metals have claimed a majority of attention. These metals, titanium and zirconium, have much in common, inasmuch as both are extracted from sand-like ores which are found together in many parts of the earth in considerable abundance. Both metals are difficult to reduce to ductile metals, but many research organizations are studying this problem and many more are investigating their uses.

Pursuing their similarity further, both metals are highly resistant to corrosion and to high temperatures. However, titanium has an edge over zirconium in that it has the added advantage of being light in weight.

Titanium is already being used in the manufacture of products where its advantages can be used profitably and where the final result is worth the cost. Since most of the uses thus far have been of a military nature, little is told about them. At the same time, companies that are staking considerable sums on the future of titanium are placing samples of the metal in the hands of potential users for research purposes.

The cost of titanium has been the chief drawback to its greater use, but developments during the past year indicate that prices may drop before too long. Allegheny Ludlum Steel Corp. and du Pont have produced, or are on the verge of producing 400-lb. ingots of the metal. The present price is about $20 per lb. When it is realized that as recently as a year ago a 10-lb. ingot of titanium metal was considered somewhat of an achievement, the 400-lb. ingots assume more importance.

Army ordnance engineers have conducted tests as to the practicability of using titanium instead of steel as cladding on tanks. Titanium is only 60% as heavy as steel and, under certain conditions, appears to be even more resistant to penetration than steel of equal thickness. Tests were successful, but this use will probably await a lowering of cost, since present costs are prohibitive.

Ductile Zirconium

Development of ductile zirconium metal has been slower than in the case of titanium, but the U. S. Bureau of Mines recently released mechanical property and fabrication data.

Zirconium metal produced by reducing the chloride with metallic magnesium has been forged and rolled at 1560 F to satisfactory sheet and rod. During these operations the zirconium was protected from oxidation by means of an iron sheath. Equally satisfactory sheet has been obtained by rolling the forged ingot at 1200 F in air. The metal can be drop forged and stamped using standard dies and equipment. Swaging and drawing are also possible.

Sheet rolled at 1560 F showed a tensile strength increase of from 63,500 to 93,500 psi. at 60% reduction with no evidence of overworking. Rockwell B hardness was increased from 86 to 98 with over 70% of the work hardening occurring during the first 20% of cold reduction. Elongation dropped from an initial 14% to 8.5% at 20% cold reduction and then remained constant up to 60% cold work.

In sheet prepared by rolling at 1200 F, annealing caused tensile strength to drop from 86,400 to 80,000 psi. at 750 F and to 59,000 psi. at 1290 F. Temperatures up to 2010 F did not materially decrease this value. Yield point values decreased from 64,400 psi. at 750 F to 33,800 psi. at 1470 F and then increased to 40,500 psi. at 2010 F. Elongation increased from 9% for the cold-worked material to 14% at 750 F, 27.5% at 1290 F and 29% at 2010 F. Complete stress relief occurred at 930 F with recrystallization complete at 1110 F.

Nickel Alloy

One of the most recent achievements in the search for alloys suitable for gas turbine parts, requiring high strength and low plastic flow rate at temperatures up to 1500 F and above, is Inconel X, a development of International Nickel Co. The material is resistant to chemical corrosion and oxidation, and represents a further advance in the long series of age-hardenable alloys evolved from the original Inconel. Its composition includes 14 to 16 chromium, 2.25 to 2.75 titanium, 0.70 to 1.20 columbium, 0.40 to 1.00 aluminum, 5 to 9 iron and 0.30 to 1.00% manganese.

Suitably heat treated, Inconel X has unusually high strength, both at ordinary temperatures and at red heat. It is far stronger than Inconel, which is only slightly age-hardenable. Inconel X also has an appreciable advantage in strength up to 1800 F, although its superiority to standard Inconel is less marked at temperatures above 1500 F. Comparative oxidation tests indicate that the oxidation resistance of Inconel X is of the same order as that of the standard alloy at temperatures up to 1600 F; above that temperature, its oxidation resistance is less than that of Inconel.

Production experience indicates that this alloy can be forged, welded and machined successfully. No unusual difficulties have been encountered. Important uses of Inconel X are in gas turbines, rotor wheels and gas turbine blades and vanes.

A cast nickel alloy, free of copper and iron and having a tensile strength of 50,000 to 60,000 psi. has been developed by Waukesha Foundry Co. Waukesha Metal Alloy No. 23, as the material is known, has an elongation of 7 to 10%, Brinell hardness of 145 to 165 (3000-kg. load). Special properties include high corrosion resistance, good machinability and good anti-seizure characteristics.

Aluminum

Newly announced during the last year was a general purpose aluminum alloy known as 150S. Aluminum Div., Permanente Products Co., developer of the alloy, claims the alloy to be intermediate between the widely used alloys 3S and 52S.

Alloy 150S is expected to be of particular interest to manufacturers of refrigeration equipment, utensils, appliances and building materials. An improvement in strength and finish of a product made from 150S as compared to the same article made of 2S or 3S is expected to overcome somewhat higher material cost.

Yield strength of 150S is put at a point between those of 3S and 52S. Workability approximates that of 3S, but finishing characteristics are superior, as is corrosion resistance. Welding and brazing characteristics likewise lie between those of the comparable alloys.

From England comes the news that aluminum is being used there as sheathing for electric power transmission cables. Sheathing is accomplished by using seamless tubing. Weight savings of from 20 to 70% have been achieved over similar lead sheathed cable. In addition to the weight savings, the aluminum sheathing is stronger than lead and can withstand higher operating temperatures. This latter feature will permit reductions in copper section of up to 25%.

A new aluminum alloy 63S primarily for decorative extrusions has been announced by Aluminum Co. of America. In addition, it is finding wide usage for tubing. The 0.4 silicon, 0.7% manganese alloy is replacing alloy 53S for many architectural uses.

Copper Alloys

A new electrical resistance alloy was recently perfected by Driver-Harris Co. The alloy has high resistivity and retains high values over wide ranges of temperature. Karma, the alloy in question, is particularly suited to use in high accuracy wire-wound resistors. Specific resistance of the alloy is more than 2.7 times that of two alloys now commonly used for such resistors.

Tensile strength of Karma at room temperature is 130,000 to 180,000 psi., which makes possible fast winding speeds. The high resistivity of the alloy permits using a larger diameter of wire with equal resistance per foot, thus adding to the physical strength of resistors for certain types of electrical equipment where strength is imperative.

Mixture 44, a new phosphor bronze alloy produced by Riverside Metal Co., has a machinability rating of 90 as compared to 100 for the best free-cutting brass or the 50 rating of Grade BI phosphor bronze. The alloy has a nominal composition of 92 copper, 4 lead and 4% tin. The alloy is available in rod, sheet, strip and bar. Mixture 44 is intended for use in screw machine parts.

A method of continuously casting bearing bronze developed by American Smelting & Refining Co. is used by Ampco Metal, Inc. to produce a dense bronze. The material is 83 copper, 7 lead, 7 tin and 3% zinc, meets the SAE 660 specification, and is designated as Asarcon. The bronze has an extremely dense, small, even grain structure which is said to eliminate a majority of costly machining difficulties encountered in similar materials produced by some other methods. Asarcon is free of porosity, dross and sand inclusions. The bearing bronze is available in a wide range of sizes in solids and hollow bars.

Two new permanent magnet materials have been launched by General Electric Co. —Alnico 5DG and Alnico 7. Alnico 5DG is a modification of Alnico 5 in which the crystal structure of the magnet is aligned in the direction of magnetization (DG refers to directional grain). As a result of this modification, smaller magnets can be used to do certain jobs requiring larger magnets. The smaller size, of course, means a reduction in weight and cost. GE feels that this material has the highest external and residual induction of any permanent magnet material known.

Alnico 7 has been developed specifically for applications where a high demagnetization force is present, as in motors, generators and variable air gap devices. This material has greater coercive force than any other grade of Alnico.

A lead alloy which offers considerably longer life for certain types of applications is a new product of National Lead Co. The alloy has high resistance to the corrosive and pitting action of chromic acid solutions. Thus, the material is ideally suited for tank linings, anodes and heating and cooling coils in chromium plating installations. Nalco Metal is said to eliminate the need for anodic treatments to reestablish lead chromate protective coatings on linings and coils.

Tests under certain typical conditions show Nalco Metal to have an 11-day corrosion loss of only 1% as compared to 50% for the 6% antimonial lead formerly used in chromium plating. In sheet form, the alloy can be cut, trimmed and shaped to tank contours. In pipe form, the metal can be coiled or looped and bound, clipped or blocked into units of any desired design or form.

Cerrocast, a new noneutectic alloy of bismuth and tin, has negligible shrinkage, and a melting range of 281 to 338 F has been made available by Cerro de Pasco Copper Corp. The alloy is finding considerable use in precision casting. Because of its long melting range Cerrocast can be readily coined to reproduce accurately the shape, dimensions and fine surface details of the master pattern. This material can be sprayed and can be used for low temperature soldering of pretinned metal parts. Cerrocast has a yield temperature of 302 F, a density of 0.296 lb. per cu. in., Brinell hardness of 22, and shrinkage of 0.0001 in. per in.

Nonmetallic Materials

In the field of nonmetallic materials, the major activity came in developments and improvement of plastics for both structural parts and as finishing materials. In this section, we will summarize plastics developments which bear on mechanical parts rather than finishes. Coating developments in plastics will be reported on in a subsequent section of this review, as will the resins used for joining purposes.

Low Pressure Plastic

One of the most interesting plastics advances is a new alkyd material which can be molded into finished form at extremely low pressure. Pressures as low as 50 psi. are being used commercially. The material is Plaskon Alkyd 411, a variant of a family of molding resins announced by Plaskon Div., Libbey-Owens-Ford Glass Co. last year. Light, inexpensive molding equipment can be used.

Alkyd 411 has mechanical and electrical properties similar to those of the granular material of the same family, although the compound has a somewhat shorter storage life. The plastic can be extruded into ribbons or other required shapes at room temperatures; the shapes can be cut into individual pieces to serve as mold charges. Alkyd 411 is believed to be particularly suited to applications where a shell of plastic must be molded around delicate

electrical assemblies which would be crushed by high pressures. The compound is being used in electrical capacitors, paper condensors and wound resistors.

New Forms of Teflon

Teflon, a plastic material developed during the war, had admirable temperature and chemical resistance properties, but was difficult to fabricate into even simple shapes. Now new forms of Teflon which overcome this major disadvantage are being produced in limited quantities. It has been learned that Teflon could be made as a suspensoid, a form in which fine particles of the resin are held suspended in a liquid. This has led to several finished product developments.

One is a compound for extruded insulation for wires which can be applied at a rate of 20 ft. per min.; another is unsupported film in improved quality and thinner gages; a third is in glass fabrics coated with Teflon. Other uses are as industrial finishes and insulating enamels.

Teflon resists attack by most chemicals except molten alkali metals up to 500 F.

Transparent Plastic

Sierra Products Co. suggests that its new material, Sierracin 212, a transparent thermosetting plastic, be used for pressurized aircraft windows and similar applications because it is noncrazing. The material can be cleaned with standard cleaners, alcohol, lacquer thinner, methylethylketone, and other solvents. Sierracin 212 has tensile strength of 10,700 psi. and flexural strength of 16,000 to 19,000 psi. It can withstand rapid changes of temperature and pressure, and has favorable creep characteristics. Forming of Sierracin 212 varies somewhat from standard procedure, but machining is accomplished by standard methods.

Phenolic Developments

Monsanto Chemical Co., Plastics Div., has a new phenolic molding powder which is reported to have high heat resistance and improved gloss and surface finish. Resinox 10231, the new material, was designed to meet the need for a phenolic powder that withstands extremes of thermal shock and still retains a high degree of gloss. The plastic has withstood exposure to temperatures of between 400 and 500 F for more than 100 hr. in tests. In one test, material was taken from room temperature into a hot oven without blistering. The material is not too critical in its molding requirements, and has a fast cure cycle.

A lower cost group of general purpose phenolic molding powders has been marketed by General Electric Co. The compounds are wood flour-filled and average 1c per lb. less than other general purpose powders. The materials have a specific gravity of 1.37 and have flow characteristics, cure time and water resistance nearly equal to more costly wood flour-filled phenolics. The new materials do not have a high gloss on long draw moldings and might show a slightly less rigid discharge from the mold, but tests by the company indicate they are satisfactory for many thermosetting plastics applications.

Tough Thermoplastic

Recently released to industry is Rayalite, a plastics development of United States Rubber Co. Rayalite is an extremely tough material made in three different compositions with tensile strengths ranging from 2,500 to 4,800 psi., modulus of rupture 3,000 to 7,500 psi., elongation at fracture of 30 to 75%, and impact strengths (notched Charpy) of 5 to 12 ft.-lb. per in. notch.

Rayalite is easily formed and can be cemented, riveted, drilled, sawed, turned and cold punched. Currently the new plastics materials are being used for such products as motion picture projector cases, luggage, bowling alley return posts, tote boxes, instrument cases and food trays. The material is available in sheeting, which comes in a variety of finishes and colors.

Another U. S. Rubber development is known as Vibrin 108. It is a thermosetting resin that permits clear color casting and impregnating. The resin is adaptable to continuous laminating or casting where color retention is required. Vibrin 108 has a specific gravity of 1.25, tensile strength of 12,000 psi., and elongation of 6%. Some uses include decorative laminates, clear castings and bag or matched die moldings by simple low pressure methods.

Sheeting and Laminates

St. Regis Paper Co. is producing a new glass phenolic laminate known as Grade 170. The laminate is extremely low in water absorption, low in power factor, and high in flexural and impact strengths. Grade 170 is being produced in sheet sizes of 36 by 36 in. and 36 by 48 in., natural color, semi-gloss finish in thickness from 1/32 in. to 2 in.

Also developed by St. Regis Paper Co. is a laminated plastic containing conductive material which enables paint application by the electrostatic spraying process. The plastic was produced for a refrigerator manufacturer who paints all parts electrostatically.

A new process for the manufacture of heavy plastic pearlescent acrylic sheets has been developed by Acryvin Corp. of America. The process permits the manufacture of sheets that are 3 ft. wide and 4 ft. long ranging from ½ to 1½ in. in thickness. Eight colors are available.

Synthane Corp. has produced a new laminated phenolic plastic with high impact and fatigue values and excellent machinability. The properties are attained by the use of a cotton mat filler with fibers running in all directions. Uniform strength can be given in all directions; even wear results, therefore, in moving parts. Known as L-RF, the laminate is available in sheet and rod.

Other Plastics Developments

Rubber-like plastics materials, Plastisol and Organosol, are being produced by Organic Coatings Div., United Chromium, Inc. The materials are reported to have high dielectric strength and good resistance to abrasion and many chemicals and corrosives. The materials are available in paste form. Plastisols are 100% solids and Organosols contain small amounts of liquid solvent or diluent. The plastics can be molded or applied as coatings by dipping, spraying or brushing. Upon baking for 20 to 30 min. at 350 F the materials set and assume a rubber-like appearance.

An extruded plastic water pipe has recently become available and is said to have a projected service life many times that of metallic pipe. Carbon EF, as the piping is known, is intended primarily for conveying water for human consumption. However, many other potential uses exist in carrying other liquids and gases.

Rubber

Several developments during the past year have made natural and man-made rubbers more useful in specific types of applications. Some of the more important of these include:

A Butaprene-based rubber compound is available from Stalwart Rubber Co. for use where rubber must withstand extremely low temperatures for prolonged periods and still remain flexible. The compound looks and acts like conventional rubber except its ability to withstand temperatures as low as —50 F. The rubber can be extruded, lathe cut, punched and molded. The composition can be altered to conform with other special requirements.

Other Stalwart Rubber developments include a gum-base natural rubber compound that is odorless, tasteless and chemically pure. The material is useful in food and chemical processing equipment. This rubber withstands 225 F for prolonged periods and 250 F for limited intervals. The material can be provided in a wide variety of shapes. A third rubber compound, available in many shapes, both standard and special, has high resistance to the action of analine, acetone, ethyl chloride and many other corrosive media.

Ceramics

High strength ceramic materials suited to the production of mechanical parts have been introduced by Coors Porcelain Co. The materials resist the effects of corrosion, wear, friction and high temperature, and can be used in electrical applications where superior dielectric properties are always required.

Physical properties vary according to the type: AI-200 Alumina has a tensile strength of 25,000 psi., compressive strength of 290,000 psi., a coefficient of expansion about 50% of that of steel, specific gravity of 3.63, and hardness comparable to natural sapphire.

Parts are made to close tolerance and fine finishes, and are machined before final hardening.

The National Bureau of Standards has also developed several ceramic bodies which have strength and creep characteristics at 1800 F and above; these are superior to the best available high temperature metal alloys. The six ceramics tested have been designed for use in jet engines and gas turbines. Tensile strengths are up to 18,000 psi. at 1800 F and 15,000 psi. at 1900 F. Above 1900 F the strengths drop off very rapidly.

Carbon and Graphite

For bearing applications, Pure Carbon Co. has produced a carbon-graphite material which is composed of extremely fine well bonded particles. Known as Puribon No. 5, the material is non-toxic and highly resistant to wear and abrasion. The material does not melt, seize or change shape when subjected to high temperatures, and is unaffected by most strong acids, alkalis and other corrosive liquids. Small bearings can be molded to size; larger bearings are molded to approximate size and then machined or ground to close tolerances.

Polymer Corp. of Pennsylvania is producing a graphite-filled Nylon in rods, cylinders and strips. The material is less expensive than unfilled Nylon and is reputed to have better wear resistance and improved frictional properties. Nylatron G is useful where a combination of rubbing and impact is involved or where normal lubrication is impossible. In addition to use as bearings, the material is suited to such applications as cams, cam followers, gears, washers, oil seal rings, valve and pump packings, etc.

Ferromagnetic Ferrite

A material with approximately 10 times the permeability of powdered iron in transformer cores is known as Ferroxcube III. It is produced by North American Philips Co. The material will, it is believed, result in greater efficiency, more compact construction and lower costs in television and radio receiver chassis. Ferroxcube III is a ferromagnetic ferrite. It is available in several standard shapes and can be produced to special requirements with high accuracy. The electrical resistivity of the material is about 10 million times that of iron.

Zirconium Boride Compound

Zirconium boride, a new metallic compound, was developed for the Office of Naval Research by American Metals Corp. The compound recently withstood survived higher temperatures than any material previously tested in turbine and rocket power plant experiments.

Other Nonmetallic Materials

Lamidall is a material composed of a tough plastic laminate bonded to ⅛-in. tempered Masonite Preswood. The product is made by Woodall Industries, Inc., in 4- by 12-ft. panels which can be fabricated to many desired shapes. This material combines the wearability of plastics and the structural qualities of pressed wood, plus offering a variety of colors and patterns.

For gasketing there has been made available a heat resisting material consisting of woven Fiberglas cloth coated with silicone rubber by Acushnet Process Co. It can be used at temperatures up to 500 F. Its present use is for such applications as a gasket between the rocker box and cover in aircraft engines. The material is now furnished in a thickness varying between 0.013 and 0.020 in.

Fabricated Parts and Forms

As might be expected from their wide applicability in industry, castings were involved in most of the year's major developments in parts and forms of interest to materials engineers. Particularly outstanding in the development of cast forms was the Bacco casting process, which combines the advantages of several forming methods, the use of frozen mercury instead of wax in investment casting, and production of large aluminum die castings.

Pressure Casting Process

The Bacco process was announced late in the year by Budds Aero Casting Co. In this process, the molten metal is poured into a die which has been heated to approximately the temperature of the metal; then high pressure is applied uniformly throughout the heated die. As a result, casting, molding, forging and coining are, in effect, combined in one operation.

The new casting process gives higher physical properties and production economy. Materials formed by the Bacco process are believed to possess about 10% greater tensile strength than the same materials formed by other casting methods; this improvement is attributed to the dense structure produced in the metal. In addition, machining can be reduced about 60% on parts made by this process as opposed to conventional means, and tolerances of 0.002 in. can be held on most dimensions. It is this feature that is most significant from an economic viewpoint, and the chief field of application for the process is expected to lie in parts where considerable machining is now required after casting.

The Bacco process has been used extensively with aluminum, and several different brasses and bronzes have been cast successfully. Although steels have been cast less than other materials, the process developers appear confident of its value in forming steel. In fact, they reported that finishes on steel parts were superior to those obtained on nonferrous parts.

Precision Castings

During the past year, interest in precision casting was heightened by the introduction of the Mercast process in which frozen mercury is substituted for wax as the pattern material.

The use of frozen mercury, of course, makes it necessary to alter somewhat the procedures used in connection with wax patterns. Since mercury freezes at —40 F, a pattern made from it must be chilled to below this temperature to solidify and hold its shape until investment is completed. And when the dipping investment is complete, the heat absorbed from the atmosphere is sufficient to liquefy the mercury and allow it to flow out of the mold. The intermediate steps of the process must be carried out in cold tanks.

Most companies which have used the Mercast process claim that it affords closer control on critical dimensions than when wax patterns are used. In one plant dimensional limits have been held within ±0.003 in. for dimensions up to 1½ in. and, on some smaller dimensions, limits as close as ±0.001 in. have been held at certain critical points in making aluminum castings.

Other advantages that have been cited for the new process are smoother surfaces, less pattern distortion, ability to attain sharper corners and thinner sections at edges, and feasibility of using larger patterns than possible with wax. On the other hand, it is generally true that processing has been somewhat slower and costs somewhat higher than for the conventional wax method. Further experience will show whether these drawbacks can be overcome or are offset by reduced machining costs.

Allis-Chalmers announced that its precision casting activity in 1949 included production of 8-lb. rotors and 12-lb. stators for oil well turbo-drills. Each of these disks is being cast with as many as 30 integral blades.

Die Castings

The potential field of application for die castings was brought into sharper focus with the successful production of the inner frame of an automobile door as an aluminum die casting. The die-cast frames weigh 13⅜ lb., a saving of 8.6 lb. per door, and measure approximately 43 by 33 in. Kaiser-Frazer Corp. and Doehler-Jarvis Corp. cooperated in designing and producing the large die casting. This development is expected to lead to further use of die castings in automobiles, with consequent reductions in weight and possibly in cost.

A plan designed to assure the die casting purchaser that proper zinc alloys and adequate processing controls have been employed in production has been set up by the American Die Casting Institute. The Certified Zinc Alloy Plan, as it is called, was put into effect last April but only recently has it been widely publicized to industry.

The plan calls for frequent sampling of castings from all participating die casting producers and subsequent analysis of these samples by an approved laboratory. Only producers whose castings continually meet established ASTM standards are permitted to use a special certification seal on their products.

In the Netherlands, a vacuum die casting process which produces parts having high dimensional accuracy was developed by N. V. Phillips' Gloeilampen-fabrieken. Parts cast by this process are free of cavities under a high gas pressure, one of the main disadvantages of ordinary die casting processes. Lead alloys and zinc alloys containing aluminum and copper have been successfully cast with the Dutch equipment, but attempts to work aluminum alloys have been largely unsuccessful because of corrosion of the feed pipe in the molten metal crucible.

Powder Metal Parts and Stampings

As an increasing number of uses were discovered for pressed metal powders, development engineers realized that powder metallurgy had reached the point where protection and decoration by electrodeposited coatings must be considered. An exploratory program commissioned by New Jersey Zinc Co. revealed that, although the nature of pressed powder surfaces raises some difficulties, most metals which can be plated in wrought form can also be plated in the form of a pressed metal powder part. It is not unlikely that these findings will make the field of powder metallurgy even more attractive to the small-quantity manufacturer and user of small parts.

Glenn L. Martin Co. has introduced a forming process which is expected to cut the cost of some formed sheet metal parts as much as 50%. The Marform process, described elsewhere in this review, offers several specific advantages from the standpoint of quality and applicability of parts produced, compared with conventional forming methods. It permits deeper draws in hard metals, and it will form sheet metal to compound curvatures and with deep-drawn flanges without wrinkling the metal. Surface finishes of the metal and coatings, such as some paints and plastics, are not affected. Also, strains in the formed parts are distributed more uniformly throughout the piece so that harmful strain concentration is avoided.

Coatings and Finishes

As has long been the case, 1949 again brought forth considerable progress in the decorative and protective coating of engineering materials. The past year has seen advances in all fields of finishing materials, including enamels, organic coatings, metallized finishes, rust-proof coatings and chemical dip finishes.

Electroplated Finishes

The usability and favorable properties resulting from gray nickel and fully-bright nickel plating baths are widely recognized. A recent process developed by Harshaw Chemical Co. now makes available an easily buffed, semi-bright nickel deposit which combines many of the desirable characteristics of both gray and bright nickel. The semi-bright bath is based on a watts-type solution.

One of the most outstanding properties of this nickel bath is its ability to fill in base metal imperfections. This property makes possible elimination of several steps in the preparation of the base metal prior to plating. The deposit requires only light pressure on a buffing wheel to bring out full brightness. Deposits are intermediate in hardness between gray and bright nickel.

Progress is being made in the electrodeposition of plastics, according to the Electrochemical Society. Most of the experimental work done thus far has been accomplished with Saran latex, and Geon. Good anodic deposits several millimeters thick were built up rapidly. Deposits, varying with process variations, can be soft, flexible and elastic or tough and stiff. Applications of electrodeposited synthetic resins include electroforming of sheets or parts, electrical insulation, and protection of metal against corrosion and abrasion. Equipment requirements are said to be simple and power consumption lower than for depositing rubber.

A British development is a new cobalt-free solution for bright nickel plating. The process is less expensive than those using cobalt and producing a coating that is bright and ductile and which shows little tendency towards pitting. The bath is easy to maintain and control on production work and has been used successfully on brass, steel and die cast zinc parts. The new bath seems to work better than cobalt-nickel on poorly polished surfaces and, therefore, can be used on inexpensive parts that do not warrant extensive preparation.

Deposits of specified thickness can be achieved in less time through use of an improved chromium plating solution developed by United Chromium, Inc. Physical and chemical properties are equal to those of deposits from conventional solutions. Faster plating is achieved because of higher cathode efficiencies and the use of higher current densities.

Metal Coatings

Lincoln Electric Co. is offering a hard surfacing powder for steel which is applied with a carbon electrode and is used to deposit a thin chromium-carbide type of hard surface to resist wear and corrosion. The powder forms a paste when mixed with water and adheres to flat and curved surfaces. Powder use is intended in circumstances where hard surfacing electrodes are not always practical: thin work, thin deposits, and for use with a.c. welders. Hardness of one-layer deposits ranges from 54 to 61 Rockwell C and 57 to 63 for multiple layers.

Wear, corrosion and oxidation resistance can be provided base metals through a process of applying a fused layer of coating metal. Both base or coating metal can be pure or alloyed, ferrous or nonferrous. The base metal must have a higher melting point than the coating metal, or the binder metal if refractory coatings are involved. Heating, necessary to attain a fusion bond, can be provided by furnace or induction, or by a special liquid bath developed by Fusion Metal Coating Co. for the process.

From France word comes that progress has been made there in spraying aluminum and magnesium with steel. Steel from low carbon types to 18:8 stainless have been successfully sprayed on the light metals. Adherence of the steel is mechanical rather than the result of alloying. The deposit is harder than the original steel but is porous. However, deposits over 0.04-in. thick are considered to be water-tight and not likely to form an electrolytic couple. If only a portion of the light alloy is covered, the potential electrolytic couple should be neutralized by a strip of sprayed zinc. The process seems interesting for applications where the weight advantages of the light metals are desired, but where wear resistance is also necessary. The deposit, because of the porous surface, has interesting self-lubricating and anti-seizing properties.

Selenium coatings for corrosion protection of magnesium-base alloys have been provided in the past by immersion in selenious acid. This method previously employed, however, reduced the fatigue strength of the magnesium considerably, and adhesion has been poor. Now by the addition of sodium dichromate to a selenium dioxide bath these disadvantages seem to have been overcome. The process involves only a simple dip in the bath for periods ranging from 5 to 30 min., depending upon the alloy.

Enamel and Ceramic Coatings

A partial solution to the problem of satisfactorily providing a vitreous enamel coating for aluminum is at least partially solved by a new frit-based enamel that can be fired on aluminum strip, sheet and castings. The coating, developed by E. I. du Pont de Nemours & Co., Inc., is fired in furnaces such as those used in firing vitreous coatings on steel, but at considerably lower temperatures.

Unlike the coatings for steel, the new aluminum finishes have the advantage of superior impact and flex resistance, good resistance to thermal shock, and they will not show rust spots if chipping should occur. Enameled aluminum can be cut and bent or formed slightly after firing. The coating is unusually resistant to mild acids. A wide range of colors can be achieved.

Aluminum so enameled is not suited to use with foods since they contain a high percentage of lead. Sanitary ware, store fronts, washing machine tubs and outdoor furniture are the type of application on which the enameled coatings are expected to be used.

NACA tests indicate that through the use of a special ceramic coating molybdenum offers potentially good service at high temperatures. The ceramic coatings are applied as water suspensions to cleaned molybdenum parts by dipping or spraying. After drying the pieces are fired at a temperature of 2150 F in an oxygen-free atmosphere.

One of the more suitable coatings consists of a base coat of a low expansion frit augmented by 20% zirconia, a cover coat containing 95% zirconia, and a seal coat consisting of a thin application of the same composition of the base coat.

A potentially important application of these ceramic coatings is the protection of molybdenum pilot tubes which are built into the nozzle end of ramjet engines used for pilotless aircraft. Although subject to gas temperatures of 3000 F, these tubes need last only 5 min. as opposed to a 45-min. service life under these conditions obtained with ceramic coated tubes.

Throughout the porcelain enameling field

there is being carried on extensive research into the field of low temperature firing enamels for steels. While not intended to replace the 1500 F enamels, they make possible the enameling of objects and materials previously not possible, using temperatures down to 1300 F. Within the next few months it is expected that more complete details as to the compositions, properties and applications of this type of enamel will be revealed.

Organic Coatings

A new synthetic finish which adheres well to metals normally difficult to paint, such as highly polished brass, stainless steel and aluminum, has been developed by Metric Lacquer Manufacturing Co. Tests show that the finish on polished brass withstands a 180-deg. bend over a ⅛-in. mandrel without cracking or flaking. Similar results have been shown on stainless steel and aluminum test panels.

On most thin gage metals baking is completed at 275 F for 15 min. Brass and thicker metals require somewhat longer times and higher temperatures. Although designed primarily for metal surfaces, the finish can be applied to phenolic plastics, using 300 F for 45 min. The coating is said to provide a hard, smooth uniform surface with high resistance to abrasion, chemicals and solvents. Although developed for spray application, it can be varied for dipping or rolling.

A new type of synthetic resin for fast-drying enamels has been developed by the Coating Resins Dept., American Cyanamid Co. The resin is a copolymer of styrene and alkyds and is known as Cycopol. Enamels made with the resin can be brushed or sprayed and are generally of the industrial type, although another use is in fast-drying household enamels. The resins are said to provide excellent toughness and adhesion to metal surfaces and have excellent color retention.

Allyl starch is now available in semi-commercial quantities for use in baked lacquers and enamels, according to General Mills Research Laboratories. Formulations using the allyl starch make hard, tough, flexible water-resistant films. Baking time varies with temperature, requiring 90 min. at 230 F, 45 min. at 255 F, down to a very few minutes at higher temperatures. The heat resistance of allyl starch makes it of interest to producers of finishes for automotive exhausts, automobile and diesel engines, steam radiators, oil refinery equipment and metal smoke stacks.

A new plastic coating designed especially for metal stampings has been developed by Black-Ox Chemical Co. The plastic coating —Krylon—shows no tendency to peel off when parts are agitated after dipping. Stampings can be handled in 2 min. after dipping and the coating hardens in 5 min. The coatings withstand a temperature range of from -70 to 225 F without cracking or peeling. They resist dilute acids, alcohols and alkalis as well as chemical fumes, grease, oil and water.

Strippable Coatings

A continuing interest in semi-temporary coatings for use during forming, storage or shipment of parts has resulted in the development of several new strippable coatings.

Minnesota Mining & Manufacturing Co. is offering a compound that is designed to be used on flat, polished stock which is to be cupped, formed or drawn. The coating protects the polished surface from scratches and abrasions. The coating is applied by spraying, brushing or roll-coating. When it has served its purpose it can be peeled off or blown off by compressed air. The coating material is available in a variety of colors, and can be used on glass and other nonporous materials as well as metals. Besides protecting against abrasion, the coating resists the actions of water, oil and gasoline.

Finishes for Plastics

United Chromium, Inc. introduced a family of coatings intended for use on Lucite, Plexiglas, Tenite II and polystyrene. The group includes both face and back coats. One series includes coatings that are available in clear, pigmented and transparent colors. This series is used on Lucite or Plexiglas which is not under stress, and is resistant to moisture, perspiration and many chemicals.

A second series, made in both pigmented and transparent colors, is used as protective and decorative coatings for polystyrene and provide a good bond without crazing. One coating in the series can be used as a wipe-in coating where indented designs are molded into polystyrene.

Another group is used as a backing coat only on Lucite, Plexiglas and Tenite II where stress is present. The coating will not cause crazing of the plastic.

A spray treatment for polystyrene surfaces has been perfected by Bee Chemical Co. and is available as clear or pigmented mixtures. The process is an improvement of an earlier development of the company in that forced drying is no longer necessary and because the compounds can now be sprayed with ordinary equipment.

Brooklyn Varnish Co. is producing an adherent finish for polyester resin-reinforced Fiberglas. The finish not only adheres well to the plastic surface, but also fills minor indentations. Filaplast can be applied by putty knife or squeege or it can be thinned and sprayed on. It dries in several hours and can be sanded. The finish can also be used as a base coat for enamels and lacquers.

Where a white surface is desired on a phenolic plastic surface, one can now be obtained through a spray coating developed by Bee Chemical Co. The material can be used where high gloss is not needed and wear conditions not too great.

Cleaning and Finishing

Since the problem of cleaning engineering materials, particularly metals, has always been high on the list of finishing headaches, it is only natural that 1949 saw many new cleaning materials become available. Most are special purpose cleaners developed primarily to overcome some particularly bothersome problem, but a few are general purpose cleaners. In the field of finishing, probably the most important development of the year was the perfecting of a chemical polishing method which is suited to most nonferrous metals. Other advances include a practical method of plating powder metal parts and a system of flame spraying plastics (polythene) on metals.

Plating Powder Metal Parts

Powder metallurgy has now reached the point where protection and decoration by electrodeposited coatings must be considered. An exploratory program carried out by Graham, Crowley & Associates for New Jersey Zinc Co. has revealed that most metals which can be plated in the wrought form can also be plated in the form of pressed powder parts. Because of the porous surfaces, however, some difficulties have been encountered.

To obtain a high luster usually requires that the surface of the piece be brought to an equivalent texture before the plating operation starts. Buffing operations for powdered metal parts require some care in the selection of buffing compounds. Greaseless compounds appear to be most suitable. Buffed parts should be precleaned in a standard soak or an emulsion cleaner and then finish cleaned by an anodic alkaline cleaning step.

In the absence of pits, powder parts can be plated directly with nickel. Some surfaces, however, might require a preliminary heavy copper coating and some surfaces might require some changes in the compacting operation before plating can be accomplished. In many cases coining or repressing after sintering have made surfaces better suited to plating.

Because of the "drag-over" due to surface porosity, powdered metal parts require careful rinsing between solutions. Thorough rinsing together with solution neutralization and use of water displacing liquids to remove entrained plating solution from pores will also help prevent "spotting out," a localized staining resulting from the seepage of plating liquids. A good lacquer film will also minimize "spotting out" difficulties, and this problem is expected to be no more serious for metal powder parts than for any other pieces.

Many difficulties have been encountered in depositing protective coatings of high-melting point metals and compounds on materials designed for high temperature service. Generally the materials are too hard or brittle to machine or work, too high-melting or chemically reactive to cast or weld, and not susceptible to electroplating.

Research presented before the Electrochemical Society indicates, however, that it is possible in many cases to apply coatings by vapor phase depositions. In addition to high-melting alloys, the carbides, nitrides, borides, silicides and oxides of these metals have been used for coatings. Among the materials coated are copper, nickel, iron, tantalum, molybdenum, tungsten, a variety

of alloy steels, graphite, porcelain, quartz, aluminum, Pyrex and carbide compounds. Wire, rod, tubing, strip and products such as pyrometer wells, die blocks, nozzles, crucibles, cyclatron and X-ray tube targets and magnetron rings have been successfully coated by this process.

Flame-Spraying Plastics

Resins of polythene (polymerized ethylene) have long been recognized as ideal coating matrials for metal surfaces where corrosion is a factor. But use of these powder coatings has been retarded because of their virtual insolubility in liquids at ordinary temperatures. Early attempts to solve this difficulty by flame spraying resulted in poor adhesion to the metal surface and excessive degradation. Now development of new spraying techniques and equipment by the Engineering Research Laboratory of E. I. du Pont de Nemours Co., Inc., has eliminated most of these troubles and metal surfaces can be coated successfully with polythene resins.

High corrosion resistance coupled with the newly-achieved ease of application makes possible wide-spread use of these resins for coating storage tanks, drums, piping, valve gates, and the like where conditions of both atmospheric and chemical deterioration exist.

A pistol designed especially for spraying polyethylene coatings has recently been developed by Schori Process Div., Ferro-Co Corp. which has been helping in making the process practical.

Chemical Polishing

A chemical polishing process which gives metals bright, reflective surfaces without mechanical or electrical operations has been developed recently by Battelle Memorial Institute, Columbus, Ohio. Only a short dip treatment is required to produce a high luster.

The polishing baths are mixtures of acids, principally phosphoric, nitric and acetic. They can be operated at room temperature up to 200 F, action of the bath being more rapid in the higher temperature range. Immersion periods vary from 10 sec. to 10 min., depending on the initial finish of the treated surface, the final finish required, and the operating bath temperature. Following the dip, the work is rinsed and dried. Plating over the polished surface can be done without further treatment of the surface.

Metals which have been polished successfully include brass, copper, nickel-silver, Monel, nickel and aluminum. Chief advantage of the process is simplicity; as many as four or five production steps have been eliminated in certain metal-finishing applications.

Cleaning

Cleaning and phosphate coating are provided in one composition developed by Detrex Corp. for use on steels and irons. Detrex 79 is a yellow, non-corrosive cleaning powder. It is used in heated water solutions at low concentrations and results in a light crystalline phosphate film on metal parts. The compound can be used in open tanks or continuous washing machines, and only about 1 min. of contact is required between spray and dip and the metal to attain the coating. Parts come from the solution with a clean water-wet surface that dries to a blue-gray finish.

Quaker Chemical Products Corp. has a new synergized synthetic cleaner which is used to remove mineral oil type soils from metals. The powder used in concentrations of 2 to 3 oz. per gal. of water in tanks is most effective at between 180 and 212 F. Cleaning is sufficiently effective to prepare the metal for Bonderizing, electroplating and painting with an immersion time of 2 min. or less. The cleaner can be used on steel, brass, zinc die castings and aluminum. A superficial etch on aluminum assists paint adhesion.

A light-duty and a heavy-duty cleaner of similar natures have been compounded by the Du Bois Co. Both cleaners are of the alkaline type, one being designed for removing light shop soils and for use in washers when cleaning aluminum. The heavy-duty cleaner will remove tenacious soils such as drawing compounds from steel parts. Both compounds are free rinsing and leave no deposits on finished work.

A non-silicated soak or electro cleaner for applications where the presence of silicate in the solution would interfere with subsequent cleaning has been developed by Hanson-Van Winkle-Munning Co. for use on steel, copper, brass, lead-base castings or die castings. Reverse electrocleaning can be used on steel to secure smut-free surfaces. The compound is used at temperatures between 160 and 200 F, with immersion times ranging from 30 sec. to 5 min., depending upon whether soak or electrocleaning is used.

Enthone, Inc., recently announced a solvent phosphoric acid type cleaner called Surprep. The compound is a liquid containing oil-displacing chemicals that dislodge oils, greases and other organic material from the metal surface so they can be wiped or rinsed off quickly. The material can be applied by brushing or wiping. In addition to its cleaning action, the cleaner also contains phosphating and rust removal chemicals which dissolve scale while the oil removal agents are operating.

Mulsolv, a synthetic emulsion degreasing agent, is intended for use in standard cleaning equipment to remove grease from metal parts prior to assembly or shipment. It is made by Bee Chemical Co.

A cleaning compound especially effective in removing polishing materials from aluminum, particularly in recessed areas, is being marketed by Northwest Chemical Co. Removal of soil is accomplished by processing the work in a bath composed of from 2 to 4 oz. per gal. of Alkalume No. 1 plus 2% by volume of Liquid Stripper No. 2 for a period of from 2 to 5 min. at 160 to 190 F temperature, depending upon the transfer time, and then rinsing. The process is applicable to manual or automatic immersion type cleaning equipment.

Plating

Electroplated coatings on aluminum are becoming more important with every expansion in use of the light metal, since it is often desirable to combine the advantages of aluminum's light weight with the properties of various coatings. A new process has now been developed for depositing zinc cadmium and tin on aluminum by chemical displacement. The development is reported by the Electrochemical Society.

Immersion deposits have sound structure and such a high degree of adhesion to aluminum that they can be used for subsequent electrodeposition of other metals. Solutions used in the process consist of the metal sulfite, hydrofluoric acid, or a fluoride salt and, in specific cases, organic addition agents. For example, the preferred composition and conditions for depositing zinc by immersion are as follows: zinc sulfate, 5N; hydrofluoric acid, 1N, time of dip, 30 to 60 sec.; temperature, 77 F.

An improved acid copper bath which makes possible plating speeds up to 0.001 in. in 10 to 15 min. and eliminates faults inherent in the original method is reported by Dayton Bright Copper Co. The method, called Daybrite, uses no cyanide or hot baths. The bath gives smooth, hard deposits which are said to tend toward filling out minor defects in the base metal, increase corrosion resistance, and simplify or eliminate buffing operations before nickel plating. The bath is also suited to electroforming operations.

Heat Treating

Progress in heat treating though unspectacular has been steady. The last year has seen a trend towards combining operations such as bright hardening and brazing or descaling and tempering. As improvements in measurement and control have come along we have seen also the extension of homogenous carburizing, whereby carbon is added to steel by heat treating in such a way that the carbon is diffused evenly throughout the cross section of steel. Some of the more interesting developments follow:

Bright Hardening and Brazing

In the past, furnace brazing has not been widely applied to tools and dies, primarily because the atmosphere requirements for tool steels have been largely unattainable in ordinary furnace equipment. Development of the Ammogus furnace, originally designed to bright heat treat tool steels, makes possible the simultaneous brazing and bright hardening of these steels. Because of the design of the batch type furnace, which has both heating and cooling chambers, a pure atmosphere of dissociated ammonia (−40 F dew point) can be maintained.

By a process developed by the Materials Engineering Dept. of Westinghouse Electric Corp., a tool steel assembly to be heat treated is given the same cycle in the furnace as if brazing was not being done. The brazing alloy is in wire or sheet form and is placed in immediate proximity to the joint to be brazed. Capillary forces will keep the molten brazing alloy in the joint while the steel is held at the austenitizing temperature for the proper soaking time. The steel, if of the air hardening type, is quenched in the atmosphere-protected cooling chamber, then tempered in the normal manner.

The broadest potentialities of this process lie in its application to those parts which,

by virtue of their complexity, involve considerable costly and complicated machining in addition to hand finishing. By making such parts in several pieces and subsequently brazed together, machining and hand-finishing can be greatly facilitated.

Tempering and Descaling

At Chevrolet-Saginaw Div. of General Motors Corp., the possibility of combining a descaling and tempering operation on forged steel bumper brackets was investigated and found practical. The brackets are made of SAE 1080 steel and are hot-formed, with the result that considerable scale forms. After being formed at 1600 F, the parts drop into an oil quench.

As currently practiced the parts, now having a hardness of from 514 to 601 Brinell, are taken through a bath containing a cleaning compound applied with pressure sprays to remove loose scale. Pieces are then dried at about 250 F in an operation that serves to preheat work for subsequent salt bath operations. The salt bath operates at 1050 F, using Virgo salt, which is a descaler. Equipment operates on the Ajax-Hultgren principle and is made by Ajax Electric Co.

Combined descaling and drawing in the salt bath requires about 4½ min. Hardness is drawn back to between 321 and 388 Brinell. Adhering scale is knocked off, partially by thermal shock, in the cold water rinse that follows. A pickle in hot muriatic acid follows to dissolve the reduced scale.

By means of the combined operations, lower costs result, less equipment is needed, and greater uniformity in work is achieved. The quality of the Bonderized surface is better than that obtained through previous pickling practice.

Homogenous Carburizing

In many cases the forming properties of low carbon steel are desirable, but service requirements of the part demand higher surface hardness and greater strength throughout. The problem is now capable of being solved, at least in steels up to 1/16-in. thick, by homogenous carburizing, which is another name for through carburizing. The process involved is a form of gas carburizing.

In principle, the steel is treated, after forming, in a furnace with a rich carbon atmosphere. How rich depends upon the final carbon level desired. The carbon content of the gas increases constantly until equilibrium is established throughout the steel. Any carbon level can be attained from 0.10% to 1.00% and, in some cases, even higher.

To through-carburize, a piece of steel 1/16-in. thick can take up to 7 or 8 hr. at a temperature between 1600 and 1700 F. Thus, the time of cycle must be balanced against other costs.

Steam Atmospheres

In the past year increased attention has been given to the possibilities of steam atmospheres for tempering and for producing thin oxide films on ferrous and nonferrous metals. The chief advantage of a steam atmosphere treatment is that such an atmosphere provides a clean scale-free surface.

One of the principal uses of a steam atmosphere is in conjunction with tempering and strain relief of ferrous parts and annealing of certain nonferrous materials. In addition, the oxide film produced by the process makes it applicable to increasing surface hardness, improved wear resistance and corrosion resistance, and increasing tool life. In some cases it shortens or eliminates pickling and offers a method of coloring steel.

The coating produced by steam treatment is a thin, tightly adherent oxide that averages about 0.0002 in. in depth. On iron and steel, blue magnetic iron oxide is formed. On nonferrous metals, the steam atmosphere inhibits oxidation and prevents discoloration and scaling. The resulting surface has no characteristic color, although it is slightly darker and duller than the untreated surface.

Carbon steels, high-speed tool steels, cast iron, sintered iron powder, beryllium copper, brass and aluminum alloys have been successfully treated.

Exposure of silicon steel laminations to a steam atmosphere at about 930 F has been found by Westinghouse Electric Corp. to produce a consistent oxide film on all grades of electrical steel, regardless of whether the silicon content is high or low. The films combine good insulation and paint adherence without changing the space factor appreciably, and have been proved under severe operating conditions.

Chromizing in Salt Bath

Several ferrous materials have been satisfactorily chromized by immersion in fused salt baths, according to a report made to the Electrochemical Society. From a cost standpoint, the new method is said to compare favorably with other methods.

Since only the surface of a corrosion resistant alloy is effective in resisting destructive attack, ordinary iron and steels having protective high-chromium alloy surfaces are often just as satisfactory as stainless steel structures. Recognition of this fact has led to the development of the various chromizing processes in which a protective case from 40 to 70% chromium at the surface is produced by heating the base either in contact with chromium metal or in an atmosphere containing a chromium halide.

According to the Electrochemical Society paper, satisfactory results were obtained at temperatures of 1650 to 2200 F by immersing parts in fused salt baths containing from 5 to 30% by weight of chromous chloride. It was found that the rate of case formation is equal to or greater than that obtained with the various pack methods at corresponding temperatures.

As in other chromizing methods, the effectiveness of the fused-salt process was found to be dependent, to a considerable extent, on choice of material. Deeper penetration at lower temperatures requires low carbon steels. Silicon apparently increases the diffusion rate, but the specific effects of other elements have not been determined.

Materials chromized by the fused salt bath method include Armco iron, two cast irons, a silicon steel, a stainless steel and SAE 1015, 1045, 2315, 3140, 4120, 4130 and 5115 steels, as well as nickel molybdenum and tungsten.

The investigation was carried on at Battelle Memorial Institute because of the Air Force's interest in chromized steels as replacements for strategic materials.

Welding and Joining

Although the attention of the welding field was fixed primarily on the rapidly developing metal arc process of inert-gas-shielded welding, this was not the only advance in joining techniques recorded during 1948. Other significant developments include improved welding controls, new brazing methods, and new bonding agents for metals and ceramics.

Gas-Shielded Process

Inert-gas-shielded welding has advanced steadily since the war as a reliable method for joining difficult-to-weld materials. The past year, however, has seen an important development in the process which greatly broadens its possible applications. In effect this development extends the advantages of the inert-gas-shielded method to heavier sections than heretofore practical and increases weld deposition control and efficiency.

This latest advance involves the use of a metal electrode instead of the virtually nonconsumable tungsten electrode originally used. The bare wire filler metal which carries the welding current is fed continuously through the shielding gas; the welding arc is maintained between the end of this wire and the work piece. Power for welding can be supplied from a standard d.c. generator and, at the present time, equipment is available for semi-automatic hand welding and for fully automatic machine welding. There is some dispute now as to whether pure helium or welding grade argon is the better shielding gas, but so far the answer to this question, as in the case of the tungsten electrode method, appears to be that each offers distinct advantages under different conditions.

The metal-arc feature, developed by The Linde Air Products Co., Air Reduction Sales Co. and Battelle Memorial Institute, was announced a little more than a year ago. At that time the new process had been applied chiefly to aluminum alloys but, in recent months, it has been used to produce high-quality welds in most of the weldable chromium-nickel stainless steels. The gas-shielded metal-arc process is also being used commercially on practically all other commonly welded nonferrous metals such as silicon bronze, aluminum bronze, copper-nickel alloys and magnesium.

In general, speeds with the gas-shielded metal-arc process are two to four times those possible with the tungsten arc method, and, as a direct result, gas consumption is two to four times lower. In addition, the new method has the other advantages of inert-gas-shielded arc welding, which include high weld quality, good appearance of finished welds, no danger of flux entrapment, and no need for flux removal.

Evidence that the development of the older tungsten arc method has not ceased was provided by the introduction of a new spot welding process making use of the inert-gas-shielded principle. Developed in order to fill a conspicuous gap between resistance and fusion welding, "poke welding" is being used successfully to join such common metals as mild steel, stainless steel and aluminum.

Welding Controls, Equipment

Increased interest in the inert-gas-shielded arc process was accompanied by continued improvement in controls and equipment for this method. With the latest control features developed by General Electric Co., two starting methods are available. The first is "touch-and-weld" starting, in which the electrode is touched to the work to initiate the starting cycle. As the electrode is lifted from the work, the pilot circuit establishes the arc and is then de-energized, usually within a total time interval of 1/100 sec. In the second starting method, the cycle is initiated by a hand or foot switch, this is particularly useful in machine welding and in manual welding where a rapid, repetitive cycle is used and where contact of the hot tungsten with the work is undesirable.

Another important development in inert-arc welding has been improved electrode holders. Recent changes in design have resulted in better visibility, lower gas consumption and lighter weight.

In the resistance welding field, G.E. engineers came through with a new slope control which materially reduces tip pickup during spot welding of aluminum, magnesium and their alloys. The new control, designed for use as an accessory with either synchronous or non-synchronous resistance welding machines of the single-phase type, provides a gradual increase in welding current at the beginning of the weld. In laboratory tests with this control, welders obtained 20 times the number of spot welds on 0.064-in. 24ST Alclad before sticking occurred than were obtained without the control. The new slope control is also believed to be advantageous for welding heavy gage steel and for projection welding, as it tends to minimize expulsion.

Later in the year Westinghouse Electric Corp. announced a d.c. welding machine designed to combine the characteristics of d.c. welding with the advantages of a.c. welding machines through the use of plate-type rectifiers.

Efficiency of the new welder at rated load is 66% as compared to 54% for an average motor-generator welder. This efficiency increases at reduced load conditions and reaches 73% at 20% of rated load, whereas the efficiency of the conventional motor generator welder falls off to 45% at this load condition. The power factor at normal operating load conditions is comparable to induction-motor-driven welders. The welder also has a greatly reduced no-load power consumption, amounting to power cost savings of 80 to 86% relative to the conventional welder.

The machine responds rapidly to the changes in current and voltage conditions produced by the welding arc. Time of recovery from rated load to short circuit or vice versa is about 0.007 sec.—considerably less than for the average motor-generator welder. Welding with electrodes at low current densities offers particularly good operation.

The new welder utilizes high-voltage selenium rectifiers, making possible a unit smaller, lighter and more efficient than other plate-type rectifiers of comparable ratings. Essentially a three-phase transformer welder, it also uses a three-phase adjustable-core-type reactor for current adjustment.

The year also found more attention being paid to the favorable characteristics of low-frequency three-phase control for resistance welding. The wave obtained from three-phase control favors a smooth flow of heat into the metal and thus increases weld quality. Used in the welding of aluminum or aluminum alloys, it greatly increases tip life; it is also believed to be advantageous in the welding of heavy sections of scaled ferrous material. In addition, the high power factor characteristic of low-frequency operation results in reduced KVA demand for any given number of amperes at the electrodes. Among current applications of three-phase control are seam and spot welding of aluminum parts for aircraft.

Studwelding Aluminum

In the past, end welding—or studwelding as it is commonly called—has been restricted to steel. Recent work by the Navy Dept., however, has made it possible to weld aluminum studs to aluminum plate. The method has been used successfully for welding insulation studs to the aluminum superstructures on ships.

The process is basically similar to studwelding as used for steel. The principal difference is that the standard studwelding gun is modified to provide for the introduction of an inert gas, such as argon or helium, which protects the molten weld metal and insures clean welds. The material used for the stud is an aluminum, 5% silicon alloy wire 3/16 in. in dia. A specially designed welding end is cold upset on the wire; then the stud blank is cut to length and threaded as required. Chemical or mechanical cleaning of the formed and threaded stud prepares it for studwelding. This size stud is limited to sheets or plates 1/8 in. thick or over, but it seems likely that smaller studs could be welded to thinner sheets. Apparently, studwelding is not limited to any particular types of aluminum-base alloys.

The British cold welding process for aluminum and other nonferrous metals has been brought over to the United States by a new company, the Koldweld Corp. In this process, developed by General Electric Co., Ltd., clean metal surfaces are forced together under pressure in specially-designed tools. Three different techniques can be used to produce straight welds, ring welds and continuous seam welds.

Welding Thermoplastics

Welding of plastics is expected to find application wherever conditions make use of extruded or molded plastics uneconomical as, for instance, in the manufacture of a small number of parts, Several welding processes have been available for thermoplastics, including heated tool welding, high frequency welding, friction welding and flame welding. To these has recently been added the hot gas welding process, perhaps the most flexible of them all.

It is quite similar in operation to gas welding of metals. Filler rods of the same composition as the material to be welded are used, and butt and fillet welds with single or multiple passes are possible. A temperature of 375 to 425 F, depending upon the material, is required at the surface of the weld. No preparation of the plastic sections is needed for materials up to 16 gage, but thicker materials should be beveled at the edges.

Contributing to the practicability of gas welding of plastics are the lower temperatures involved (compared to metal welding) and the fact that plastic welds appear to have the same chemical resistance as the parent material.

Brazing Developments

A one-step method of brazing nonmetallic materials, such as ceramics, carbides, sapphires and diamonds, to metals was developed at Massachusetts Institute of Technology. It is carried out in controlled atmospheres or in vacuum without fluxes and provides a bond which, in many cases, exceeds the strength of the nonmetallic material. Hydrides of titanium, zirconium, tantalum and columbium, and alloys prepared from both metal hydrides and pure metals have been found suitable in producing the brazing alloy which wets and bonds both metals and nonmetals.

One procedure involves coating the surfaces to be brazed with a thin film of the metallic hydride. A water paste or a nitrocellulose-solution binder works equally well in producing a thin, uniform coating of the hydride. A piece of suitable solder is then placed in contact with the hydride-coated surface and the material is heated to approximatly 1830 F in a vacuum of about 10^{-4} mm. mercury or better in hydrogen or inert gas. When the proper temperature is reached, the brazing alloy will melt and flow over the hydride-coated surface in a manner similar to the brazing of metals.

Alternatively, an alloy such as zirconium hydride can be heated in a vacuum at 1470 to 1830 F, removing hydrogen and leaving a relatively pure zirconium metal powder. This partially sintered powder can be exposed to air and then used in a manner similar to the hydride to produce an equally good braze.

Year's end brought with it the marketing of copper in paste form by the Metals Refining Co., a division of Glidden Co. The copper paste is expected to provide substantial savings in the assembly of parts for furnace copper brazing. Company engineers believe "Cubond" can be applied with more speed and less waste than conventional sources such as rings, foil, slugs and electroplate. To accentuate these advantages, the company has developed applicator guns which apply Cubond as an

extrusion in the form of rounds or ribbons in definite quantity.

Adhesives

That part of industry which is always on the lookout for better adhesives for joining similar and dissimilar materials could take its choice from among a number of new bonding agents announced during the year. One of these, a high-strength adhesive developed by B. F. Goodrich Co. and General Motors Research Laboratory, is said to have twice the safety of rivets. This particular material has been used for bonding linings to truck and passenger car brake shoes, entirely eliminating rivets and substantially increasing brake life and efficiency.

Perhaps the most interesting arrivals in this field, however, were the ethoxyline resins supplied under the trade name "Araldit" by Ciba Limited, of Switzerland. Ethoxyline is the designation given a new class of resins in which aliphatic-aromatic chain molecules have at their ends a reactive ethylene oxide group. These resins, which can be cured either at elevated temperatures or at room temperature without splitting off volatile substances, exhibit great adhesion to almost all materials plus high mechanical strength and good durability.

Shaping and Forming

The last year has seen a number of significant advances in the forming of metals. One process—the cold extrusion of steel—finally evolved from the talking stage into a practical reality. Another technique, known as the Bacco process, represents a unique combination of forging and casting methods. And, equally important, the theoretical economies of "hot machining" to increase cutting rates were shown to have basis in fact.

Cold Extrusion of Steel

It would be difficult to pinpoint the origin of interest in cold extrusion of steel, but its practical development in the United States can be traced to a German post-war process brought here by Heintz Manufacturing Co. Whereas the Germans extruded only killed SAE 1010, however, the process is being used in this country for higher carbon steels as well as alloy steels containing chromium, nickel, manganese and some molybdenum.

The theory behind the new process might be summarized in the concept that most steel is completely plastic, even at ordinary temperatures; for this reason, steel can be extruded cold. A principal feature of cold extrusion is the use of a crystalline metal phosphate coating—a lubricant film so strong that it remains unbroken even under tremendous pressure.

Generally, cold-extruded shapes offer fine finish, close tolerances and high physical properties. Tensile strength as high as 100,000 psi. with 15% elongation has been obtained for low carbon steel; in some cases elongation has reached 70%. Rimmed 1010 steel has been extruded to give 85% reduction in cross-section area. The increases in strength resulting from this new forming method have made possible correspondingly thinner sections for many parts, and as a rule these parts represent a 90% yield of original stock weight.

On the other side of the ledger must be put the fact that extrusion of cold steel requires about twice as much power as drawing. And the stresses which can be withstood by the extrusion dies must be taken into account as an important limiting factor. Nevertheless, solid and hollow tubular shapes produced by cold extrusion are being used, in several instances, to replace forgings and castings and to reduce waste in screw machine parts.

A similarly optimistic note on steel processing was sounded by a French concern which announced that it has a new extrusion process expected to save up to 30% or more on steel fabricating costs. Developed and patented by a subsidiary of Société d'Électro-Chimie d'Électro-Metallurgie et des Aciéries Électrique d'Ugine, the process is said to make possible the extrusion of extremely intricate forms and sections, thus eliminating many costly forging and machining operations. One accomplishment claimed for the new forming method is the production of finished alloy gears in two operations. The Ugine process may turn out to be another modification of German cold extrusion methods but, at year's end, no further details were available.

Combined Casting and Forging

An interesting combination of the casting and forging processes has been worked out by Budd Aero Casting Co.; several aspects of this process have been reviewed under *Fabricated Parts and Forms*. Essentially, the method consists of pouring the molten metal into a die which has been heated to approximately the temperature of the metal and then applying pressure uniformly throughout the heated die.

Exerting constant pressure on the die while the metal is setting up tends to force out impurities and gases. The elimination of gases largely solves the shrinkage problem, and, consequently, the dies can be made to final dimensions with rather close tolerances being attained on the finished parts.

Most significant from the forging viewpoint, however, is the fact that early in the cycle extra pressure is placed on the die to obtain a forging action. This procedure results in parts with dense structure, higher strength and smooth finish. The time cycle for the Bacco process, as it is known, is slower than mold die casting or sand casting. Nevertheless, it has proved economical on suitable parts because of savings in machining and finishing time. Although there will undoubtedly be practical limits to the size of parts made by this process, theoretically the only limitation is the size of press available to produce the relatively high pressures required during the solidification part of the forming cycle.

Hot Machining

The high strength properties and mass production requirements of many new alloys often make milling an extremely difficult operation. Ordinarily, reasonable tool life can be obtained in these cases by reducing cutting speed and feed and cooling the cutter. During the past year, however, considerable attention has been given to the possibility of alleviating this machinability problem by pre-heating difficult work, by furnace or induction, to temperatures ranging from 1000 to 1500 F and machining at those temperatures. The theory behind this practice seems to be that the machine tool will perform more efficiently if its friction energy is not dissipated in the generation of heat.

That this postulate has some basis in fact was shown by a compairson of power requirements; for, despite the heating expense incurred by this process, overall power requirements were generally reduced. And the results from a production standpoint have been phenomenally successful.

The effectiveness of the hot machining process appears to be much more pronounced for difficult alloys than for ordinary steel and low alloys. For instance, a machining temperature of 1500 F increased possible metal removal by about 300% for an ordinary steel. The same temperature, however, increased the machining rate for Allegheny Ludlum's S-816, a high-cobalt low-iron high-temperature alloy, from 2.1 cu. in. per hr. to 4.5 cu. in. per min. or 270 cu. in. per hr. This 134-fold increase was achieved with good finish and long tool life. Thus, it would appear that one of the chief deterrents in the specification of high temperature alloys may no longer be valid.

Controlled Forming Process

In recent years there has been much interest in the applicability of true-stress-natural-strain diagrams as opposed to the conventional tensile test diagrams. In this connection it has been pointed out that use of the true stress-strain curve in designing for forming operations would permit deeper draws in many instances. With the announcement of the Marform process this year by Glenn L. Martin Co., it appears that some of these ideas may be finding their way into actual production use.

Martin engineers have estimated that this process can cut production costs for formed sheet metal parts as much as 50%; as a result, they forecast savings of hundreds of thousands of dollars annually for the aircraft industry. They say the process depends upon close control of the pressure curve which prevents formation of wrinkles and reduces springback to a minimum.

Some of the specific advantages claimed for the Marform process are as follows: it will form sheet metal to compound curvatures and with deep-drawn flanges without wrinkling the metal; it permits deep draws in harder metals; it eliminates finish-forming of parts by hand as now required on parts formed with rubber in the hydro-press and on some die-formed parts; several different parts, having complicated contours but similar pressure curves, can be formed at the same time; parts can be formed of varied materials and thicknesses within a reasonable range with little or no effect on tooling; material wall thickness in a deep drawn part is maintained practically uniform from the blank to the finished formed part; and it can be adapted readily to hot forming.

Materials Engineering File Facts

NUMBER 185
January, 1950

MATERIALS: Stainless Steels
METHODS: Heat Treating

Problems and Remedies in Heat Treating Stainless Steels

Problem	Probable Causes	Remedies
Low or non-uniform hardness after hardening.	1. Hardening temperature too low or not uniform. 2. Decarburization causing thin, soft skin.	Check (a) recommended temperature and time, (b) thermocouples, and (c) hardness testing procedure. Grind off 1/16 in. and recheck hardness. If then satisfactory, parts probably overheated, exposed to open flame, or held too long at temperature.
Hardness not uniform after tempering.	1. Tempering temperatures not uniform. 2. Decarburization present on hardened material.	1. Charge and space parts so as to maintain uniform temperature. 2. Check hardening procedure as above.
Too low impact strength in Types 403, 410, 414 and 431 after stress relief.	1. Hardening temperature too low. 2. Stress-relieving temperature too high.	1. Use high side of hardening range. 2. Do not stress-relieve over 750 F.
Too low impact strength in Types 403, 410, 414 and 431 after tempering.	1. Hardening temperature too high. 2. Tempering temperature too low.	1. Use low side of hardening range. 2. Tempering under 1000 F not recommended.
Low tensile elastic properties in Types 403, 410, 414, 416 and 431 after tempering.	Excessive cold working, such as may occur in straightening of heat treated parts.	Stress-relieving at 100 deg. below tempering temperature for 1 to 2 hr. will restore elastic properties.
Cracking of hardened parts.	1. Too drastic quenching. 2. Poor design, too sharp fillets at corners.	Check for accumulation of water at bottom of oil bath. Quench in oil warmed to 250 F, or air-cool. Do not allow fully hardened parts to lie around and become cold; stress-relieve them after cooling below 400 F.
Distortion of hardened parts.	1. Non-uniform heating. 2. Too drastic quenching.	1. Heat parts slowly and uniformly to hardening temperatures. 2. Air-cool instead of oil-quench.
Coarse grains and brittleness in Types 430, 442 and 446.	Overheating	Air-cooling from 1800 F and above, as in forging and welding, followed by annealing will improve toughness but does not reduce grain size.
Severe etching or corrosion of parts when pickled or passivated.	Carburization of surface.	Remove all carbonaceous material from contact with parts when treating. Check salt baths for presence of cyanides or other carburizing materials.
Intergranular corrosion of chromium-nickel ("300" series) grades. Rough sandy surface when pickled.	1. Carburization, zinc penetration. 2. Too low annealing temperature. 3. Too slow quenching.	1. Remove carbonaceous material as above. 2. Check correct annealing temperature. 3. Do not allow parts to cool slowly through range from 1650 to 800 F.
Network of fine strain cracks on surface of hardened parts after pickling and/or grinding (high-carbon grades).	1. Pickling fully hardened parts. 2. Overheating in grinding.	1. High-carbon grades should be stress-relieved before pickling in hardened condition. 2. Avoid abusive grinding treatment.
Pitting of heat-treated parts when pickled.	Reducing gases in furnace atmosphere.	Keep atmosphere on oxidizing side. Burners may be clogged and require cleaning.
Scale difficult to remove.	Reducing gases in furnace atmosphere.	Keep atmosphere oxidizing. Loosen scale by sulfuric acid, alkaline solutions or molten caustics, preceded by tumbling if necessary. Remove scale and whiten steel surface by nitric acid containing hydrofluoric acid.
Discoloration of parts when passivated.	Incorrect passivation procedure.	Use sodium dichromate in passivating baths to avert clouding or etching of highly polished parts of chromium stainless steels.

Adapted from material supplied by Armco Steel Corp., Middletown, Ohio

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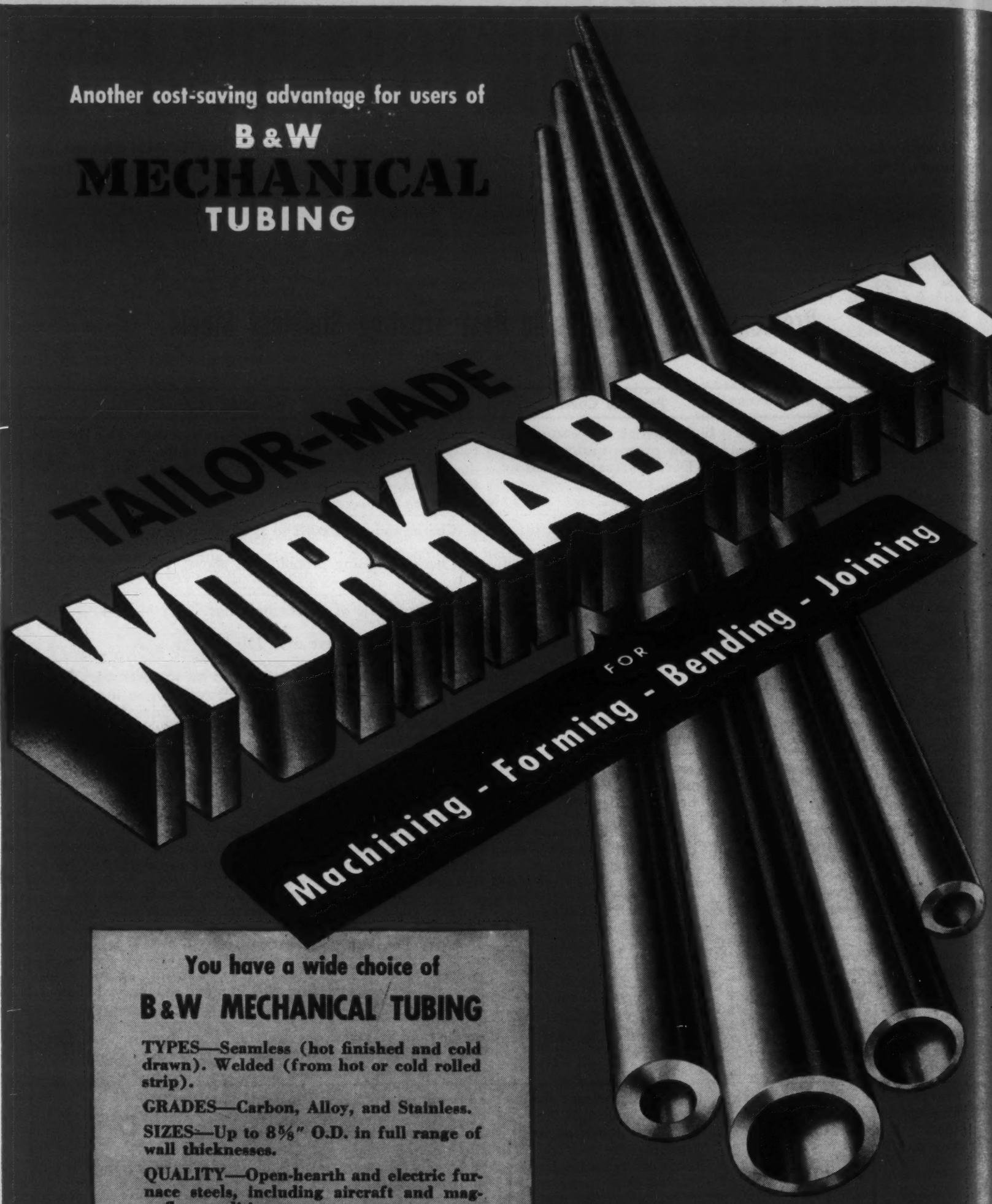

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SIZES—Up to 8⅝" O.D. in full range of wall thicknesses.

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SURFACE FINISHES — As rolled, as drawn, as welded, bead removed, turned, scale-free, and polished.

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Materials Engineering File Facts

NUMBER 186
January, 1950

Identification of Metal Plate Deposits

Lacquer coatings, when present, should be removed with thinner, after which the metal deposit is scratch brushed lightly or scrubbed with a paste of magnesia powder and water and rinsed well. The deposit is then treated with a solution of equal parts of nitric acid and water for about 2 min.

Plating Not Attacked by Nitric Acid:

Indicates aluminum, chromium, gold or platinum group metals (palladium, platinum, rhodium).

1. *Gold:* A colored deposit unattacked by nitric acid would be gold or a gold alloy.
2. *Aluminum:* Treat the deposit with 10% caustic soda solution. If it is attacked, aluminum is indicated.
3. *Chromium:* Treat the deposit with concentrated hydrochloric acid. Development of a green solution indicates chromium.
4. *Platinum Group Metals:* White deposits that are unaffected by either nitric acid or hydrochloric acid are in this group.

Plating Attacked by Nitric Acid:

A. Blue or Green Solution: Indicates chromium, copper, copper alloys or nickel.

1. *Copper:* Evaporate the solution to dryness. Dissolve the residue in 1 cc. of 20% by volume solution of sulfuric acid, then dilute to 100 cc. Immerse an iron nail in this solution for 4 hr. A red coating indicates copper or a copper alloy.
2. *Nickel:* Make the solution alkaline to litmus with concentrated ammonia and add 1 cc. of a 1% solution of dimethylglyoxime in 95% ethyl alcohol. A flocculent reddish or pink precipitate indicates nickel.
3. *Chromium:* If the tests for nickel and copper are negative, the deposit is chromium.

B. Cloudy White Solution: Indicates tin. Dissolve another sample in concentrated hydrochloric acid and add solid cacotheline. A reddish-violet color will confirm the presence of tin.

C. Colorless Solution: Indicates cadmium, lead, silver or zinc.

1. *Zinc:* Make the solution alkaline to litmus with concentrated ammonia. Then add 10% sodium sulfide solution. A white precipitate indicates zinc.
2. *Cadmium:* Make the solution alkaline to litmus with concentrated ammonia. Then add 10% sodium sulfide solution. A yellow precipitate indicates cadmium.
3. *Silver:* Add 10% caustic soda solution until the solution is alkaline to litmus. A brownish-black precipitate indicates silver.
4. *Lead:* If zinc and cadmium are absent, add 10% caustic soda solution until the solution is alkaline to litmus. A white precipitate indicates lead.

In making tests for deposits by the above procedure, it is very important to be certain that the attack noted is attack of the deposit and not of the basis metal. For example, in the case of gold deposits on brass, a blue solution will be obtained in a few seconds if the deposit is thin. Insoluble flakes of gold, however, will be seen to be present in the resultant solution.

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New Materials and Equipment

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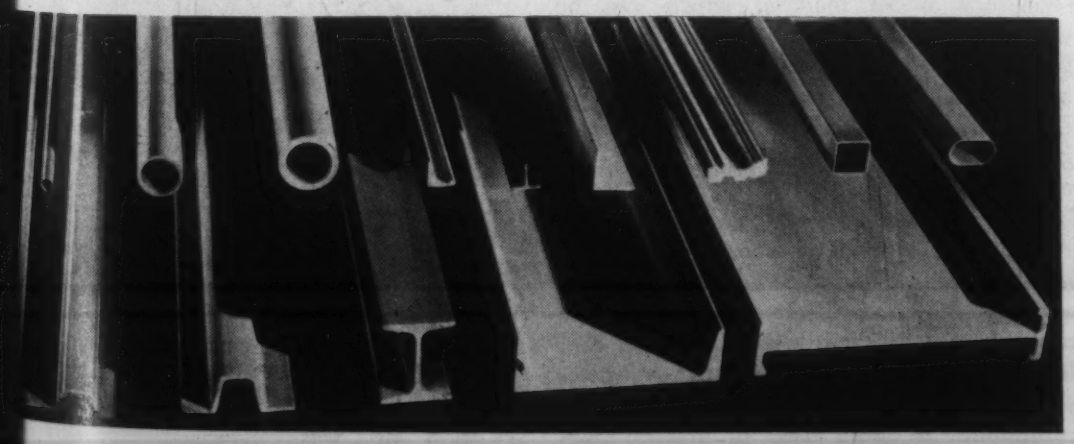
Metals

Magnesium Extrusion Alloy

Increased toughness, relative insensitivity o notch effect, and good impact toughness nd fatigue strength are claimed for an mproved magnesium extrusion alloy now vailable in large commercial quantities rom *Dow Chemical Co.*, Midland, Mich. Designated as ZK60, the alloy contains 6 inc and 0.6% zirconium. It has been escribed previously in MATERIALS & METHODS (July 1948, p. 67).

Whereas the compressive yield strength f other wrought magnesium alloys is only 0 to 70% of the tensile yield strength, he tensile and compressive yield strengths f ZK60 are substantially the same. Experiental work showed that the high strength roperties are due mainly to small grain ze, which is maintained by the addition of zirconium. The extrusion conditions, such as speed, temperature and reduction of cross-sectional area, also contribute to these strength properties.

An outstanding application of ZK60 is its use for floor beams in airplanes. Early investigation showed that beams built up from formed sheet of any other metal would be unnecessarily heavy because of the excess materials needed at the joints. Extrusions of other light metals, on the other hand, were too heavy because process limitations prevented making a web sufficiently thin for structural efficiency. Use of ZK60 extrusions of bulkier section have made possible an efficient and more rigid design with reported weight saving of 5% and cost saving of 25%.



Dow's magnesium extrusion alloy, ZK60, is now available in commercial quantities.

Although the first major uses of ZK60 have been in the aircraft field, it is expected that its favorable strength properties plus light weight will make it applicable to truck and trailer floor sills and parts, textile machinery, materials handling equipment, and many other commercial applications.

Phosphor Bronze Alloy

A new phosphor bronze alloy, Mixture 44, which has a high machinability rating, has been developed by *Riverside Metal Co.*, Riverside, N. J. Its machinability rating is 90% compared to the best free-cutting brass rating of 100% or Grade B1 phosphor bronze rating of 50%.

This alloy has a nominal composition of 92 copper, 4 lead and 4% tin. The high lead content allows the alloy to be machined to closer tolerances and at higher cutting speeds without burning or scoring the cutters, and lack of zinc content makes Mixture 44 useful for applications where zinc cannot be tolerated.

Available in rods, sheets, strips and bars, Mixture 44 is claimed to simplify machining problems for manufacturers of screw-machined and similar bronze or phosphor bronze parts.

New Materials and Equipment
(CONTINUED)

Plastics

Non-Crazing Plastic

A transparent thermosetting plastic which is claimed to be non-crazing has been announced by *Sierra Products Co.*, 1632 E. Compton Blvd., Compton, Calif. The product, Sierracin 212, has been used for pressurized aircraft windows and other aircraft parts.

The new plastic was developed especially for applications where crazing, caused by the effects of pressure, cleaning compounds or mounting cements, could not be tolerated. Sierracin 212 can be cleaned with any standard cleaner or with alcohol, methylethylketone, lacquer thinner, etc.

Some of the properties of this material are listed below:

Specific gravity	1.20
Barcal hardness	36 to 42
Tensile strength	10,700 psi.
Flexural strength	16 to 19,000 psi.
Luminous light transmission	89%
Volume resistivity	10.5 ohm-cm.
Dielectric constant (60 cycles)	3.3 to 3.5

The material is claimed to withstand rapid changes of temperature and pressure without adverse effect. Low load tests at elevated temperatures have demonstrated favorable creep properties.

The process of forming Sierracin varies somewhat from standard procedures and is usually varied further according to the requirements of any given part. Machining, on the other hand, is accomplished easily by all standard methods. A laminating cement produced by this company makes it possible to cement Sierracin to practically any material, including metal, wood, glass and plastic.

New Forms of Teflon

New forms of Teflon tetrafluoroethylene resin will enable industry, for the first time, to take full advantage of this material's great resistance to high temperatures and chemical corrosion, according to a recent announcement by *E. I. du Pont de Nemours & Co. (Inc.)*, Wilmington 98, Del. The new forms are not yet in commercial production but are available in experimental quantities.

Previously Teflon, developed during the war, has been difficult to fabricate; only by slow and costly methods has it been possible to use the plastic for relatively simple shapes with limited industrial uses. The discovery that Teflon could be made as a suspensoid, a form in which fine particles of the plastic are held suspended in a liquid, has led to five new finished-product developments expected to have considerable application:

1. Industrial finishes which can be applied to metals with paint-spraying equipment, *e.g.*, to give chemical tanks corrosion resistant linings.
2. Enamels for insulating fine wire which can be coated at a rate of about 50 ft. per min. on standard wire-coating machinery, *e.g.*, wire for electric motors, transformers and generators.
3. Compounds for extruding heavier insulation onto wire at rates of 20 ft. per min. up, in contrast with the present rate of 6 ft. per hr.
4. Unsupported Teflon film of improved quality and in thinner gages.
5. Glass fabrics coated with Teflon.

Teflon resists attack by almost all chemicals, except molten alkali metals, up to 500 F. Its heat resistance makes it possible to increase power capacities of electric motors substantially without increasing size. It is expected that its tendency to resist sticking to other materials may make it applicable as an anti-sticking coating for rubber and polythene plastic molds.

Low-Pressure Molding Plastic

A new alkyd material which can be molded into finished form at pressures considerably lower than any other plastic material has been announced by the *Plaskon Div. of Libbey-Owens-Ford Glass Co.* Molding pressures as low as 50 psi. are being used commercially.

This new material, designated as Plaskon Alkyd 411, is one of a family of alkyd molding plastics introduced about a year ago by Plaskon. These plastics can be molded on equipment which is lighter and less expensive than conventional compression presses. The original alkyd, a granular compound, is being used in making television components, switch gear, fuse plugs, terminal blocks and machine parts. The new material is supplied to molders in bulk as a putty.

Mechanical and electrical properties of Plaskon Alkyd 411 are similar to those of the granular material, although the new compound has somewhat shorter storage life. It can be readily extruded into ribbons or other required shapes at room temperatures; these shapes can then be cut into individual pieces, which serve as mold charges. In this way, molders can preassemble a condensor or capacitor just before molding and produce an integral piece with all components, including wire leads, sealed into a stable, moisture-resistant, heat-resistant unit.

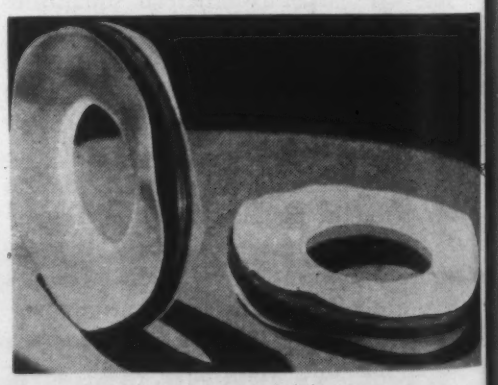
Because of its low pressure requirements, Alkyd 411 is believed to be particularly suited to applications where a shell of plastic must be molded around delicate electrical assemblies which would be crushed by the high pressures necessary to mold other plastics. The compound has been used in electrical capacitors, paper condensors and wound resistors.

Parts and Forms

Non-Corroding Adaptor

A non-corroding adaptor which provides a tight seal between glass-coated steel pipe and vessels of any material has been announced by *United States Gasket Co.*, 602 N. 10th St., Camden, N. J.

The Teflon jacket, which is the only part of the adaptor exposed to material within



Shown here are non-corroding adaptors made by United States Gasket Co.

the pipe, is claimed to be inert to all industrial chemicals and to withstand temperatures up to 550 F and down to —150 F.

Plastic Pipe

An extruded plastic pipe, claimed to have a projected service life many times that of metallic pipe, has been made available by *Carter Products Corp.*, 10235 Meech Ave., Cleveland 5, Ohio. The pipe, known as Carlon EF, was developed especially to handle water intended for human consump-

"MAKE A TON OF SHEET STEEL GO FARTHER"
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This is no idle promise. It is a proved fact, demonstrated day after day in the production of widely varied parts and products. Three tons of N-A-X HIGH-TENSILE are yielding as many finished units as were previously yielded by *four* tons of carbon sheet steel.

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At a time when America must make full use of its steel-producing capacities and conserve its natural resources, the trend to N-A-X HIGH-TENSILE has national significance. Each ton produced represents a potential 33% increase in finished goods of superior quality. Investigate the opportunity to make each ton of sheet steel go farther—through the superior quality of N-A-X HIGH-TENSILE.

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- Apply paste only to parts of work that require case-hardening.
- Rapid penetration: .030 inches in 30 minutes.
- The easiest and quickest way of carburizing.
- No special equipment needed—For the first time pack-hardening is possible even where no furnace is available.
- Garburit is being widely used in large completely equipped plants as well as in small maintenance shops.
- Not poisonous—not toxic.

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Test Carburit and convince yourself

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New Materials and Equipment

tion, but is thought to be suitable for many diversified applications.

Carlon EF has tensile strength of 1400 psi., neglible water absorption, slow burning rate, dielectric strength of 500 v. per Mil (⅛-in. thickness), and flexural strength varying from 1500 to 1700 psi. Its impact resistance at temperatures ranging from −50 to 140 F is similar to that of soft rubber. Like all plastics, Carlon EF is an insulator and will not form a galvanic couple, thus eliminating the problem of electrolytic corrosion. Good resistance to chemicals and sunlight are reported for this pipe. It is recommended for working temperatures up to 140 F only.

Long sections of Carlon EF can be handled easily and quickly by one man, who can lay the pipe and make joints in as little as 2 min. A 25-ft. length of 6-in. pipe, for example, weighs about 55 lb.; a 100-ft. coil of 3-in. pipe weighs approximately 91 lb. Pipe and fittings (with stainless steel clamps) are available in all standard pipe sizes from ½ to 6 in.

Possible uses of the plastic pipe, in addition to carrying water, include transmission of natural or artificial gases, plating tank solutions, cold chemicals, industrial sewage, corrosive gases, and as radiant heating coils.

Stainless Steel Hose

The *Alloy Tube Div. of Carpenter Steel Co.,* Union, N. J., is now producing flexible hose in its highly corrosion resistant alloy, Carpenter Stainless No. 20. Previously, flexible stainless hose has been available only in conventional analyses, such as Types 304, 316 and 347.

Size range of available hose is from about 1 to 2⅝ in. I.D. in various gages.

Finishes

Finish for Fiberglas

An adherent finish for polyester resin-reinforced fiberglas has been developed by *Brooklyn Varnish Manufacturing Co., Inc.,* 50 Jay St., Brooklyn 1, N. Y. Named Tuf-On Filaplast, the new finish not only adheres to fiberglas and plastic surfaces but also fills indentations wherever they occur.

Filaplast, which is based on phenolic resins, can be applied by putty knife or

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- ....while rest of workpiece is being hardened. Prevents decarburization and scaling.
- Easy to apply and easy to remove.
- It slows down the cooling of protected sections so much that no hardness will be obtained even if steel contains high percentage of carbon.
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ALL IRON CASTINGS ON BLISS PRESSES ARE MEEHANITE® METAL

E. W. BLISS COMPANY, Detroit, Michigan, prominent manufacturers of a line of mechanical and hydraulic presses as well as other machinery, operate two Meehanite foundries. The hundreds of tons of Meehanite castings produced in these plants are used as structural components for their products.

In their line of presses ranging from a small Inclinable Press, Figure 1, to the Giant deep-drawing Toggle Press, Figure 2, Meehanite castings are used for such important parts as frames, flywheels, brake and clutch housings, connections, slides, etc. Presses of these types must be rugged and must perform precision work. Their design must incorporate maximum rigidity for die life with a proper safety factor below the elastic limit of the structural material in order to be sure of eliminating permanent set. Meehanite castings provide these qualities accompanied by resistance to fatigue and impact, high compressive and tensile strength and excellent vibration absorption qualities.

For further facts about the importance of quality castings as units of construction write for the bulletin "The Vital Component—Good Castings." For a copy write to any of the foundries listed.

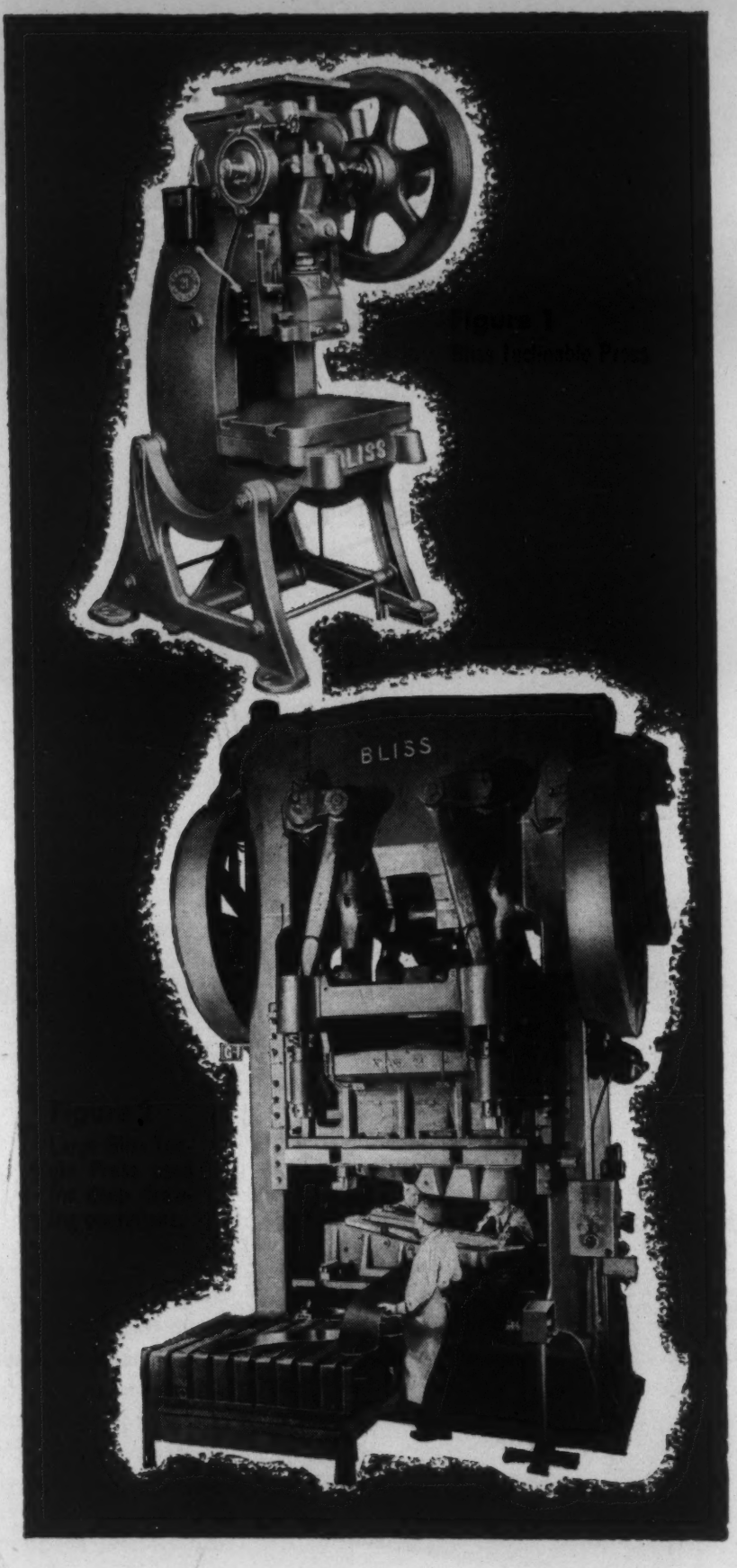


Figure 1
Bliss Inclinable Press

MEEHANITE FOUNDRIES

American Brake Shoe Co. ..... Mahwah, N. J.
The American Laundry Machinery Co. Rochester, N. Y.
Atlas Foundry Co. ..... Detroit, Mich.
Banner Iron Works ..... St. Louis, Mo.
Barnett Foundry & Machine Co. ..... Irvington, N. J.
E. W. Bliss Co. ..... Hastings, Mich. and Toledo, O.
Builders Iron Foundry Inc. ..... Providence, R. I.
H. W. Butterworth & Sons Co. ..... Bethayres, Pa.
Continental Gin Co. ..... Birmingham, Ala.
The Cooper-Bessemer Corp. Mt. Vernon, O. and Grove City, Pa.
Crawford & Doherty Foundry Co. ..... Portland, Ore.
Farrel-Birmingham Co., Inc. ..... Ansonia, Conn.
Florence Pipe Foundry & Machine Co. .. Florence, N. J.
Fulton Foundry & Machine Co., Inc. ..... Cleveland, O.
General Foundry & Manufacturing Co. .... Flint, Mich.
Greenlee Foundry Co. ..... Chicago, Ill.
The Hamilton Foundry & Machine Co. .... Hamilton, O.
The Henry Perkins Co. ..... Bridgewater, Mass.
Johnstone Foundries, Inc. ..... Grove City, Pa.
Kanawha Manufacturing Co. ..... Charleston, W. Va.
Koehring Co. ..... Milwaukee, Wis.
Lincoln Foundry Corp. ..... Los Angeles, Calif.
E. Long Ltd. ..... Orillia, Ont.
Otis-Fensom Elevator Co., Ltd. ..... Hamilton, Ont.
Pohlman Foundry Co., Inc. ..... Buffalo, N. Y.
The Prescott Co. ..... Menominee, Mich.
Rosedale Foundry & Machine Co. ..... Pittsburgh, Pa.
Ross-Meehan Foundries ..... Chattanooga, Tenn.
Shenango-Penn Mold Co. ..... Dover, O.
Sonith Industries, Inc. ..... Indianapolis, Ind.
Standard Foundry Co. ..... Worcester, Mass.
The Stearns-Roger Manufacturing Co. .. Denver, Colo.
Traylor Engineering & Mfg. Co. ..... Allentown, Pa.
Valley Iron Works, Inc. ..... St. Paul, Minn.
Vulcan Foundry Co. ..... Oakland, Calif.
Warren Foundry & Pipe Corporation Phillipsburg, N. J.

"This advertisement sponsored by foundries listed above."

Meehanite® NEW ROCHELLE, N. Y.

THE ONLY WAY YOU CAN BEAT FORGINGS AS A SALES FEATURE IS TO USE MORE FORGINGS

A REFERENCE BOOK ON FORGINGS FOR ALL USERS OF METAL PARTS

60 pages of authoritative information on metal quality as developed in forgings formed through the use of closed impression dies. Forging production techniques are described and illustrated; economic advantages of forgings are presented from the viewpoint of top management, design engineers, metallurgists and production executives. Your copy is ready. Fill in and attach coupon below to your business letterhead.

● What a forging *has*—can't be duplicated! No other method of fabricating parts utilizes fully the fiber-like flow line structure of wrought metals. Thus, forgings provide matchless capacity for the toughest work loads and fortify your product for better performance. Forgings forestall and reduce downtime due to failure of highly stressed parts; provide a factor of greater safety for men and machines. A recheck of every stressed part, as well as simple handles and levers, frequently reveals opportunities to improve a product, to reduce the cost of machining and finishing or to speed up assembly. Consult a forging engineer—only a forging engineer can inform you fully regarding the many quality advantages and cost-reducing possibilities that are obtainable with forgings.

DROP FORGING ASSOCIATION
605 HANNA BUILDING
CLEVELAND 15, OHIO

Please send 60-page booklet entitled "Metal Quality—How Hot Working Improves Properties of Metals", 1949 Edition.

NAME_____
POSITION_____
COMPANY_____
ADDRESS_____

New Materials and Equipment

squeegee, or it can be thinned for spray application. It sands easily and dries in several hours. Filaplast is also claimed to provide a good base coat for enamels and lacquers.

Burnishing Compound

A new burnishing powder called Burnish-All, which has been used successfully on brass, steel, lead, silver and gold, and on zinc die castings, is being produced by *Chemclean Products Corp.*, 64 Sixth Ave., New York.

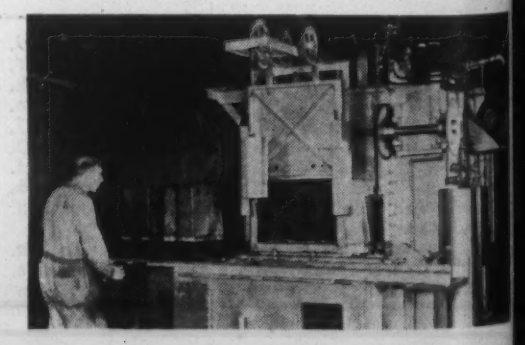
It is claimed to bring up a more brilliant lustre on most metals in less time than is usually required by other materials now being used. It is said to be equally effective when used either with burnishing medium or in self-rolling operations.

Heat Treating

Radiant Tube Fired Unit

A new batch-type radiant tube fired furnace for controlled atmosphere heat treatments has been developed by *Surface Combustion Corp.*, Toledo 1, Ohio. High production and versatility at low cost are claimed for this unit.

The fast heating resulting from radiant tube firing, combined with forced circulation, makes possible production up to 200 lb. per hr. gross load per square foot of area. The furnace has a maximum gross



The new batch-type furnace produced by Surface Combustion Corp. is used for high production controlled atmosphere work.

charge capacity up to 2500 lb., depending upon the type of work to be processed.

The furnace is available with the built-in RX atmosphere generator to provide for carburizing, cyaniding and carbon restoration, as well as protection during general

Where does Felt serve in your Factory?

There isn't a plant in this country that does not make use of felt in some way. It is one of the hidden but important engineering materials that help industry make better products and improve plant operations. In an automobile, for example, there are some 90 different applications of felt, and in an automobile plant at least another 90. Many of these are not apparent by casual inspection but long life, smooth performance, freedom from vibration and positive lubrication are frequently the result of well engineered, reliable felt parts. Check your plant and your products — are you making full use of the many advantages offered by felt?

1 MOTORS 2 VIBRATION MOUNTINGS 3 SHOCK DAMPENERS 4 GENERATORS 5 OIL BURNERS 6 HANGER OILERS 7 BALL BEARINGS 8 ROLLER BEARINGS 9 WORKERS' FLOOR PADS 10 BUFFING WHEELS 11 CASTERS 12 TRUCKS 13 PASSENGER CARS 14 TRACTORS 15 FAUCETS 16 OIL CONTAINERS 17 DUST SHIELDS 18 WORK SHOES 19 OIL WIPERS 20 FILTERS 21 VENTILATORS 22 WICKS 23 THERMAL INSULATION 24 GRINDING GOGGLE SHIELDS 26 FOUNDRY GLOVES 27 RESPIRATORS 28 SANDER BELTS 29 HOSPITAL SUPPLIES 30 COMMISSARY EQUIPMENT 31 WEATHERSTRIP 32 BULLETIN BOARDS 33 SWITCH BOARDS 34 RELAY BOARDS 35 TELEPHONES 36 TELETYPE 37 TELEGRAPH 38 P. A. SYSTEM 39 RADIOS 40 BUSINESS MACHINES 41 TYPEWRITERS 42 DUPLICATING MACHINES 43 POLISHING 44 CHAIR PADS 45 LEDGER CORNERS 46 DOOR BUMPERS 47 GLASS DESK TOP STRIPS 48 BLOTTER PADS 49 TABLE TOPS 50 AIR CONDITIONING 51 COLD LINE INSULATION 52 SOUND ABSORPTION 53 ASH TRAY BASES 54 CIGAR LIGHTERS 55 LAUNDRY EQUIPMENT 56 INSULATION 57 SEWING MACHINES

uses shown here are mainly generic, because there are hundreds of places in the modern factory where felt is used. American felt is made in many standardized types, and is an engineered fabric that can be specified as accurately as any other material.

American Felt Company

TRADE MARK

GENERAL OFFICES: 24 Glenville Road, Glenville, Conn. — ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn. — PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I. — SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, Montreal.

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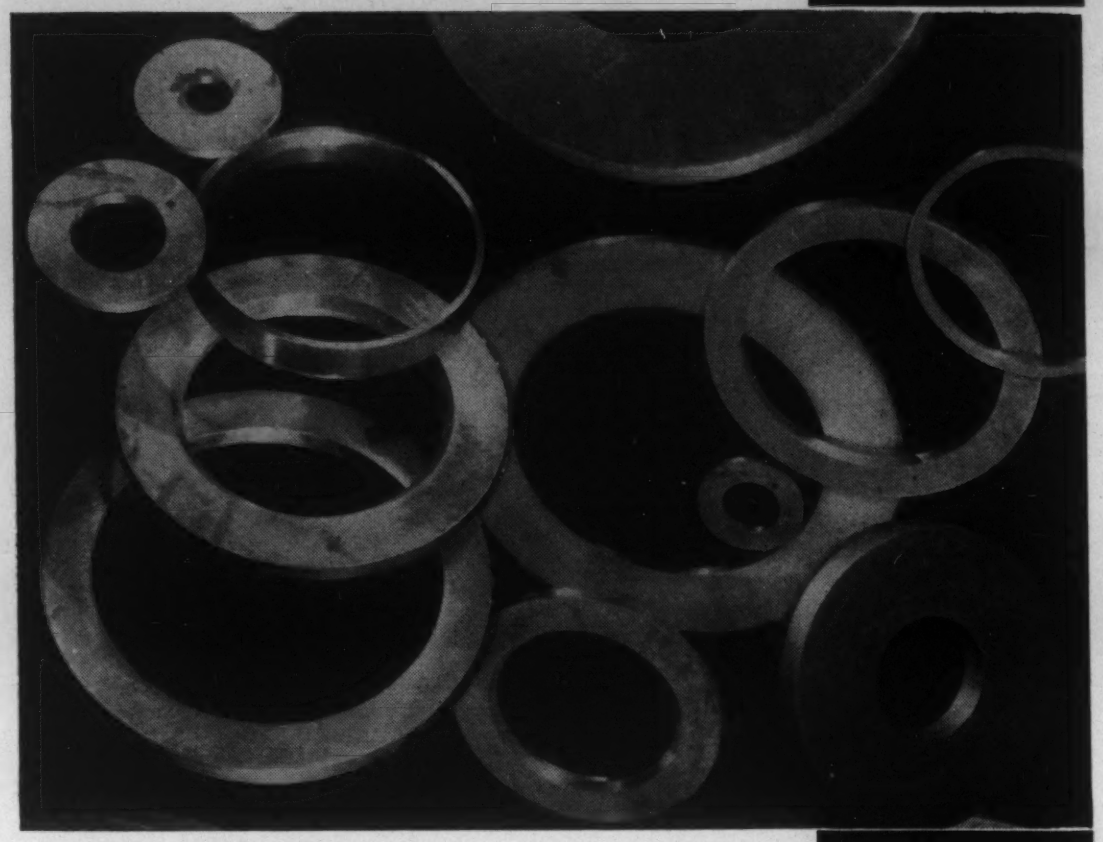


You Gain

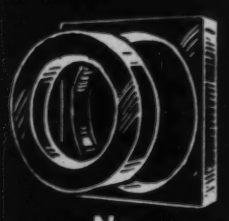
WHEN YOU ORDER

STAINLESS RINGS

FROM

G.O. CARLSON, INC.

1. No dead weight—no scrap—no freight on excess material.
2. Carlson cutting equipment and trained personnel makes it possible to produce rings from our plate at minimum cost.
3. Carlson stainless steel rings are available in any size, thickness and quantity.
4. Rings are delivered rough cut or rough machined from plate, or forged and rough machined.
5. Ring flanges also available—plain, bevelled, or threaded on ID and bolt holes.



No Excess Material

Any Size, Thickness and Quantity

★ All Stainless Analyses

G. O. Carlson, Inc. supplies stainless steel plates in all analyses to chemical industry standards. Take advantage of our specialization . . . your inquiry will be given prompt attention.

G.O. CARLSON, INC.

Stainless Steels Exclusively

200 Marshalton Road, Thorndale, Pa.

PLATES • FORGINGS • BILLETS • BARS • SHEETS (No. 1 Finish)

District Sales Offices and Warehouse Offices in Principal Cities

New Materials and Equipment

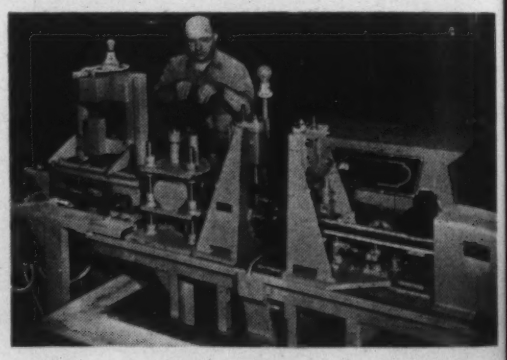
heat treating. Four trays, moved by alloy screws, carry the work in and out of the furnace. A "lowerator" quench mechanism provides semi-automatic operation for charging and discharging.

Induction Hardening Unit

Continuous selective induction hardening of cylindrical parts at feed rates up to 6 in. per sec. is possible with equipment now available from *Westinghouse Electric Corp.*, P. O. Box 868, Pittsburgh 30, Pa.

This equipment is claimed to harden a wide variety of cylindrical parts in any desired hardness pattern by simple adjustment of electronic timing circuits. It consists of three major components: an Automatic Loading Device; a Horizontal Rotating Scanner; and an Industrial Radio-Frequency Generator.

The pieces to be hardened are fed to the scanner through a feeder unit by the Auto-



Cylindrical feed rates up to 6 in. per sec. are possible with this Westinghouse induction hardening equipment.

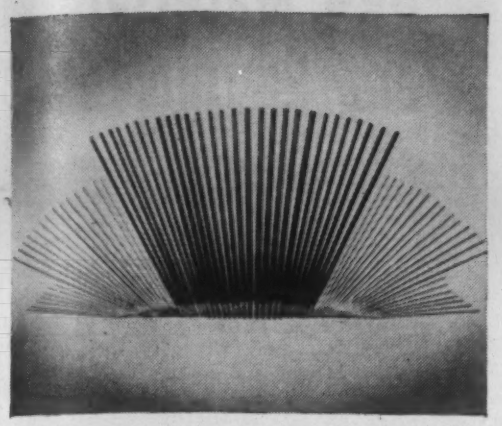
matic Loader, consisting of a magazine and hopper. The work is hardened as it passes through an inductor coil and spray quench ring. Controlled feeds assure uniformity of case depth, and positive grade and rotation of the cylindrical work piece about its longitudinal axis provide concentricity of case.

Bench-Type Furnace

A new furnace for operation to 1850 F is being offered by *Cooley Electric Manufacturing Corp.*, 38 S. Shelby St., Indianapolis, Ind., to meet a demand for greater capacity in bench-type heat treating furnace equipment. The furnace has chamber dimensions of 10 in. wide by 8 in. high by 18 in. long, and is available in two models, VH-48 and VK-48.

The VK-48 model is equipped with a Cooley Selective Power Modifier which permits manual setting of power input at any point from 5 to 100% of full rating. This

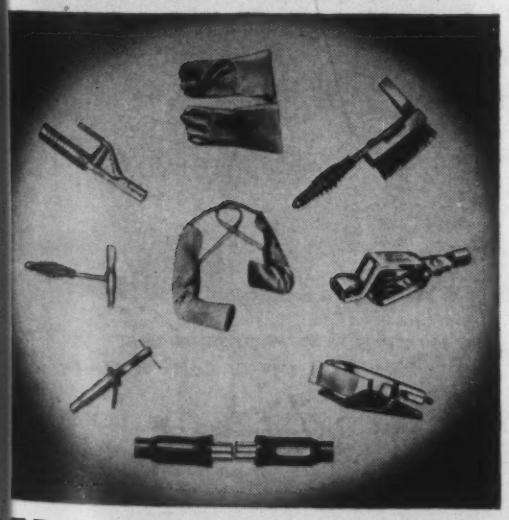
FACTS AVAILABLE ON "SELECT 70"



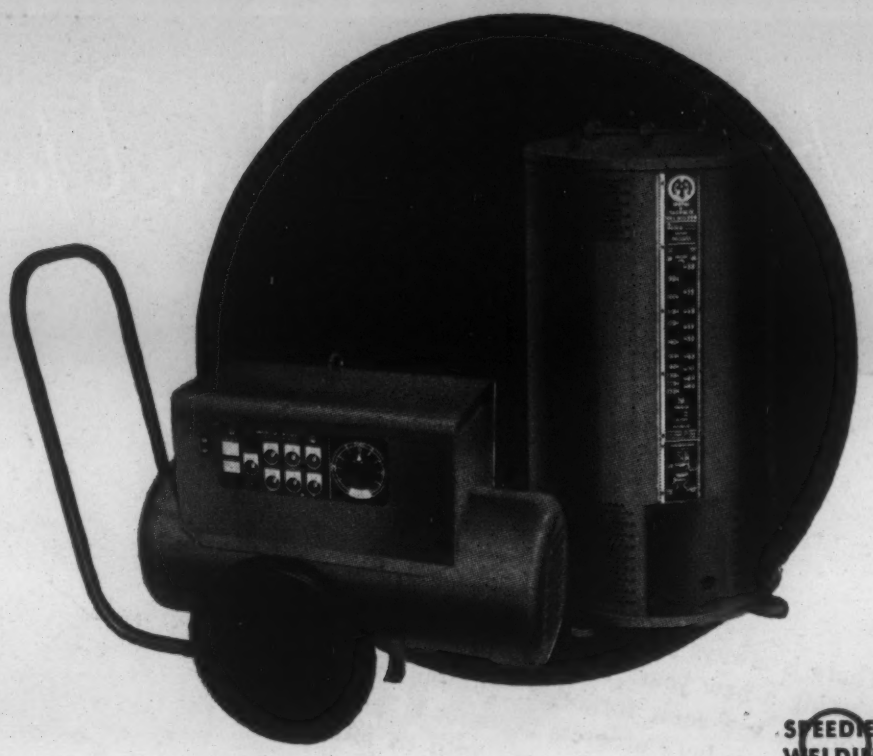
DESCRIPTIVE literature covering mild steel, low alloy and special steel, stainless steel, hard surfacing and build up and other special electrodes is available to those requesting full information on M & T's "SELECT 70"— seventy electrodes designed to cover all arc welding requirements—AC or DC, all-position or downhand work welding of mild steel, low alloys and stainless steels as well as hard surfacing and building up of worn parts.

Literature is brief but comprehensive, covering specifications, properties and applications for each electrode. Copies available on request received on company letterhead. Address Metal and Thermit Corporation, 120 Broadway, New York 5, N. Y.

ACCESSORY DIVIDENDS DECLARED



UNDERSCORING the importance of proper accessories to top welding performance, more and more fabricators are taking pains with selection of accessories. Speedier, lower cost, safer and improved welding are assured when such items as helmets, shields, holders, connectors, cleaning tools and protective clothing are carefully selected. And more and more fabricators—sold on M & T electrode and arc welder performance — are specifying the M & T line of "accessories to the perfect weld." For descriptive literature, address Metal and Thermit Corporation, 120 Broadway, New York 5, N. Y.



SPEEDIER WELDING

QUALITY

LOWER COST

APT COMPANIONS TO MUREX ELECTRODES-

ENGINEERED TO GIVE YOU BETTER WELDER PERFORMANCE

You'll experience entirely new arc welder performance—faster welding, better quality welds, lower power costs, and less maintenance—with the new, up-to-the-minute M & T AC and DC arc welders.

AC units feature *Built-in Capacitors* for low operating cost... *Fingertip, Stepless Current Control* for precise welding current... *Wide Current Range* plus *Ample Overtravel* for full rated output with long electrode leads. Furnished in 200 to 500 amp models for manual work; others for inert arc and automatic welding.

DC units are *Compact and Lightweight*... half as big and half as heavy as older types... yet are built for full capacity, rugged industrial duty... and are equipped with *Automatic Current Selector*. Available in 150 to 400 amp models—motor-driven, engine-driven, belt-drive.

M & T welding machines go hand in hand with M & T's "Select 70" group of electrodes and with M & T accessories to provide everything needed for arc welding... arc welding of top-notch quality. Write today for descriptive data.

METAL & THERMIT CORPORATION

120 Broadway • New York 5, N. Y.

CHICAGO NEWARK CHICOPEE FALLS CLEVELAND PITTSBURGH HOUSTON SO. SAN FRANCISCO WARRENTON YORKVILLE

Beginning a New Year

1950

There is always something refreshing about beginning a new year. Yesterday's difficulties and troubles are soon forgotten, but on the other hand, yesterday's progress becomes a "plus factor" that we gratefully carry with us into the new year.

In reviewing our progress during 1949, we find that two new warehouses got off to a good start in Seattle, Washington and Portland, Oregon. Facilities for fabricating reinforcing bars were placed in operation in several districts. Aircraft Alloy Steels were added to meet increasing requirements of aircraft industries. And, to more completely satisfy the metal requirements of all our customers, Reynolds Lifetime Aluminum products were made available through many of our warehouses. This expansion, both product and area-wise will improve service to steel users in all parts of the country.

To us, good service has come to mean . . . a warehouse or sales office near your place of business; complete and diversified stocks for your every need; modern facilities for cutting, processing and handling materials; fast efficient delivery service . . . and a staff who know their business. These are the kind of advantages that so many of our customers have termed "Service *Plus.*"

We take this occasion to extend to you our cordial best wishes for a happy and prosperous New Year.

When you deal with us you get **Service Plus!**

UNITED STATES STEEL SUPPLY COMPANY

Warehouses: BALTIMORE • BOSTON • CHICAGO
CLEVELAND • LOS ANGELES • MILWAUKEE • MOLINE, ILL. • NEWARK • PITTSBURGH
PORTLAND, ORE. • SAN FRANCISCO • SEATTLE • ST. LOUIS • TWIN CITY (ST. PAUL)
Also Sales Offices at: KANSAS CITY, MO. • PHILADELPHIA • TOLEDO • TULSA • YOUNGSTOWN
Headquarters Offices: 208 S. La Salle St. — Chicago 4, Ill.

USS

UNITED STATES STEEL

New Materials and Equipment

feature, together with a control pyrometer, enables close regulation of both high and low temperatures.

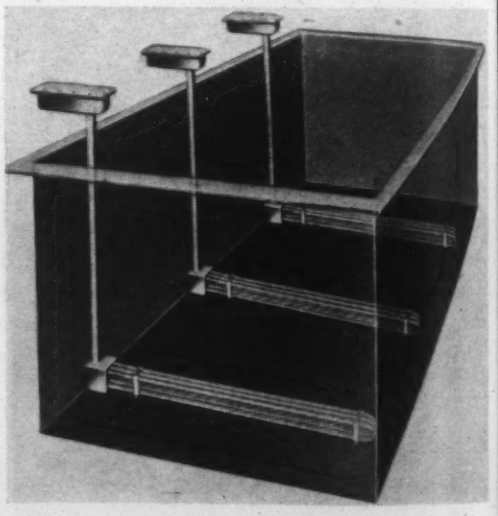
The VH-48 model does not have the power modifier and is adapted to hardening and tempering operations where uniformity at the lower temperature is not too critical.

Either model is said to be useful in tool and die hardening and tempering, and as a furnace for batch production runs of small parts. The size and shape of the working space makes these two models especially suitable for pack hardening.

Cleaning and Finishing

Immersion Heater

A portable tank immersion heater suitable for solvent cleaners has been announced by *Edwin L. Wiegand Co.*, 7500 Thomas



This immersion heating tank made by Wiegand can be used for solvent cleaners.

Blvd., Pittsburgh 8, Pa. The heaters are rated from 2 to 8 kw., 115 or 550 v., single- or three-phase. Copper, steel, Inconel or stainless steel sheath is available.

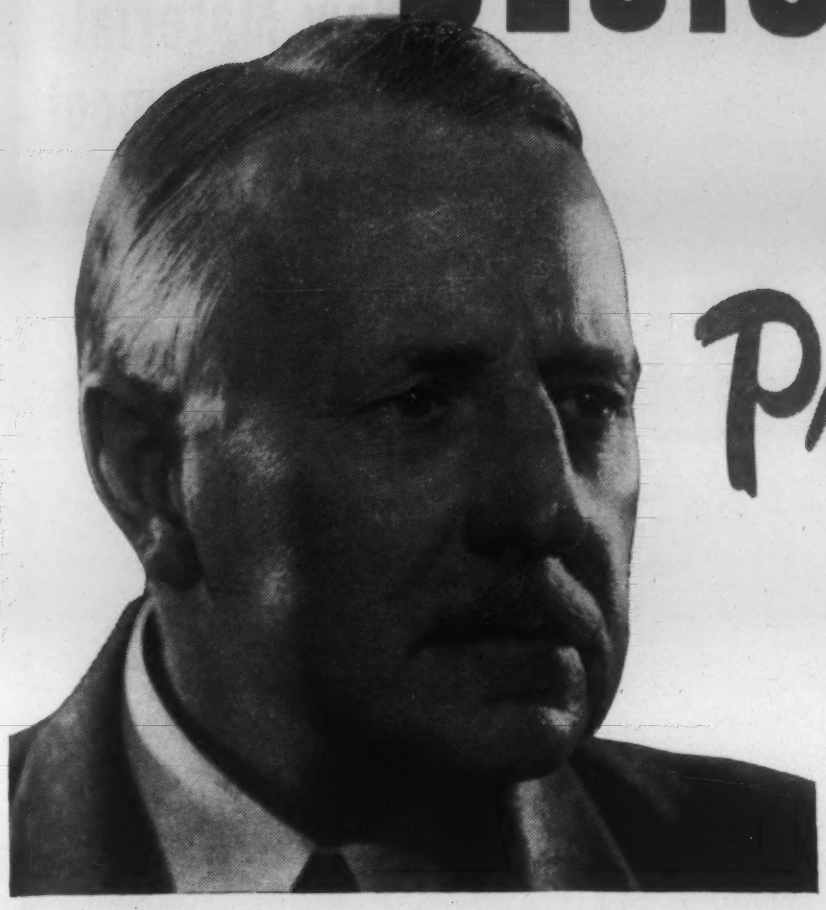
Welding and Brazing

Welding Regulator

A welding and cutting regulator which maintains constant volume and pressure of gas without requiring two-stage reduction has been announced by *National Cylinder Gas Co.*, 840 N. Michigan Ave., Chicago 11, Ill.

Previously, only the two-stage regulator, of relatively complex construction, could

DESIGNERS...



make Product Costs help Sale-ability!

"One of the best ways to enhance a product's sale-ability is to design with materials that symbolize top quality and fabricate readily at low cost."

Hussey Copper exactly answers these requirements because its durability, efficiency and lasting beauty are acknowledged characteristics of finest quality to the buyer. To the manufacturer, Hussey Copper means versatility, good electrical and thermal conductivity, easy forming, stamping, turning or spinning, and simplified fastening by soldering, brazing, riveting, bolting—or even by lamination to other materials. These characteristics spell manufacturing economies that make low production costs enhance sale-ability.

Design with an eye to sale-ability of your finished product. Design with Hussey Copper to help keep production costs low enough to assure a fair retail price. You will find a ready supply of Hussey Copper in any of the seven complete Hussey Copper Warehouses.

C. G. HUSSEY & COMPANY
(Division of Copper Range Co.)
ROLLING MILLS AND GENERAL OFFICES: PITTSBURGH, PA.
Hussey Warehouses carry stocks of Copper and Brass Products for Prompt Shipment

7 convenient warehouses to serve you promptly!

PITTSBURGH, 2850 Second Avenue • CLEVELAND, 5318 St. Clair Avenue • NEW YORK, 140 Sixth Avenue • CHICAGO, 3900 N. Elston Avenue • ST. LOUIS, 1620 Delmar Boulevard • PHILADELPHIA, 1632 Fairmount Avenue • CINCINNATI, 424 Commercial Square

Our 102nd Year

HUSSEY

HOW TO REDUCE YOUR REFRACTORY MAINTENANCE COSTS...

with the new

3X BLAZECRETE

3000° F

Just mix with water ... flip into place ... trowel smooth — *no laborious ramming or tamping required!*

3X Blazecrete hardens after 6 hours of air curing. After that, it can either be fired or left standing indefinitely. It's furnished dry, and any unmixed or unused 3X Blazecrete left over from the job can be stored for future use!

3X Blazecrete is unusually effective for heavy patching, especially where brickwork is spalled, or deeply eroded. It has exceptional adherence qualities.

Use it with gunning equipment, too

When applied by gun, 3X Blazecrete makes an unusually strong, dense and homogeneous lining or wall. It adheres readily with a minimum of loss when "shot" into place. Available in 100-lb bags. 155 lbs per cu. ft. is required for gunning; 130 lbs per cu. ft. for troweling. For further information write Johns-Manville, Box 290, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

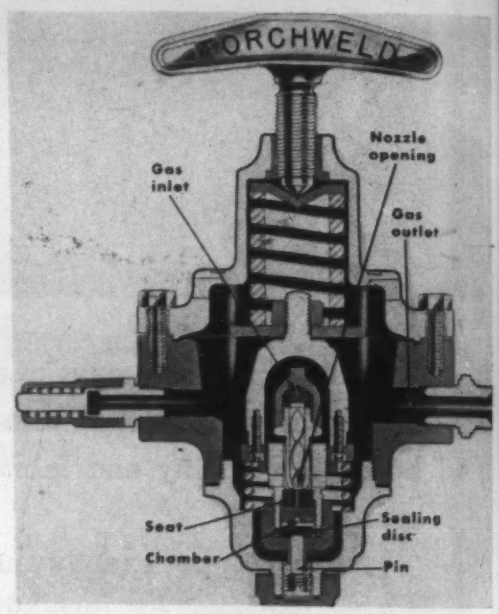
3X BLAZECRETE

for patching and gunning

New Materials and Equipment

maintain constant delivery pressure despite the decrease in supply pressure occurring as gas is withdrawn from a cylinder. The new Torchweld 6500, however, has a pressure-compensating unit in the valve seat assembly which counteracts effects of decreasing cylinder pressure.

The compensating unit consists of a small gas chamber below the valve seat,



The Torchweld 6500 regulator features simplified design.

a reinforced-rubber sealing disk at the bottom of the chamber, and a pin resting between the disk and the back cap of the regulator. Gas at cylinder pressure passes into the chamber, which is part of the movable seat assembly, through an orifice in the seat. The force of the gas results in an action that moves the seat gradually away from the nozzle as supply pressure decreases, thus maintaining a constant rate of flow.

Small Shop Welding Outfit

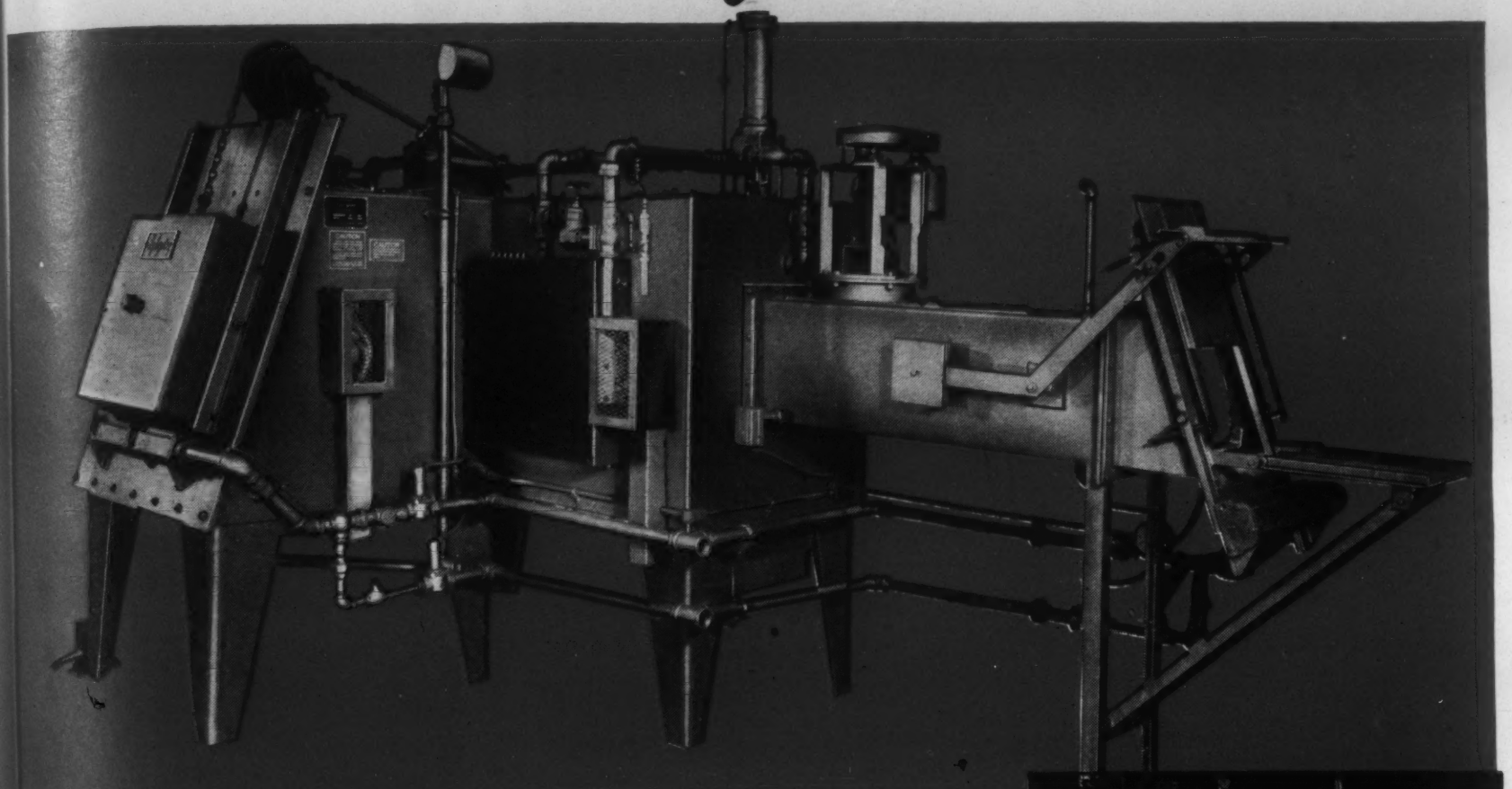
An oxyacetylene welding and cutting outfit designed for small-quantity users is being produced by *Air Reduction Sales Co.*, 60 E. 42 St., New York 17.

The unit, known as "Flamecraft," is being marketed as a "package," including oxygen and acetylene cylinders, welding torch, cutting attachment, tips, regulators, hose, goggles, cylinder truck, fluxes, an assortment of welding and hardfacing rods, and an instruction folder.

Spot Welder Accessory

A lightweight steel stand designed to increase the versatility of its recently-marketed portable and self-operating spot welder has been introduced by *Greyhound A. C. Arc Welder Corp.*, 606 Johnson Ave.,

Announcing a new process for heat treating High-Speed Steels!



THE LINDBERG "L-TYPE" FURNACE

This revolutionary new furnace is designed to harden precision high-speed tools completely scale free and without discoloration. It is ideal for tools with fine cutting edges that cannot be ground or cleaned after hardening.

Unique in construction and appearance—preheat, high heat and quench are combined in one unit—designed for complete atmosphere protection from start to finish. The "L-Type" Furnace is the result of three years of research and a year and a half of testing in the Lindberg Commercial Heat Treating Plants. It is the FIRST MAJOR ADVANCE in hardening high-speed steels since the introduction of atmosphere treating.

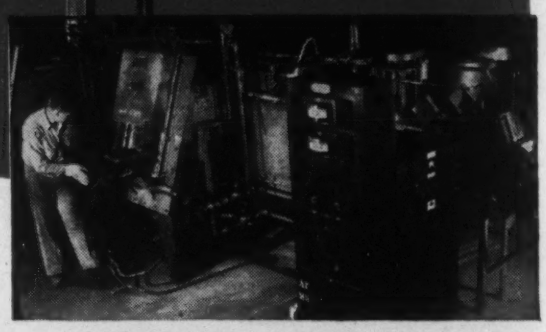
COMPLETELY ELIMINATES

- . . . cracking of tools due to quenching strains
- . . . removing scale by sandblasting or grinding
- . . . drastic dimensional changes during processing
- . . . oil quench tank and oil cooling system
- . . . washing quench oil from work
- . . . decarburization and carburization troubles

OFFERS MANY ADVANTAGES

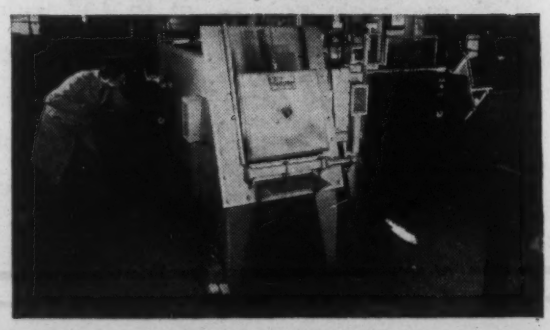
Improved surface appearance... Increased tool life... Decreased heating costs... Decreased atmosphere costs... Improved working conditions... Not limited to high speed steels.

Write for Bulletin No. 220 for full details.



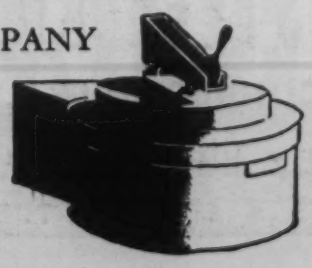
LOS ANGELES, CALIFORNIA

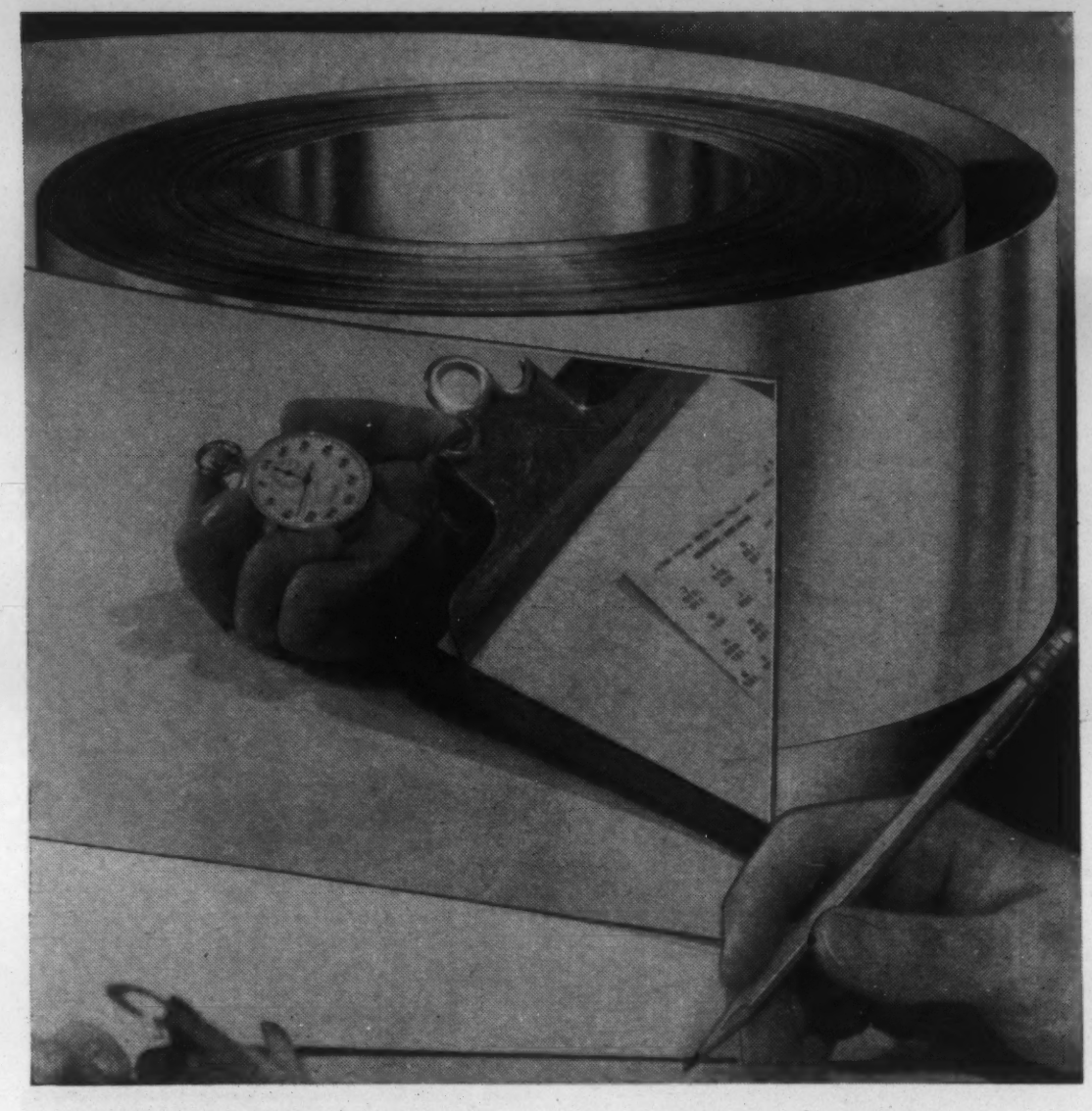
ST. LOUIS, MISSOURI



CHICAGO, ILLINOIS

LINDBERG ENGINEERING COMPANY 2451 W. Hubbard Street, Chicago 12, Illinois

LINDBERG  **FURNACES**



To Cut Production Costs . . .
"START WITH THE FINISH"

Actual unretouched photo graphically illustrates huge savings in time reflected in Wallingford Steel's 18-8 Bright Annealed Stainless.

WALLINGFORD 18-8
Bright Annealed
STAINLESS STRIP

Seems everyone is interested in cutting production costs these days. Inquiries on Wallingford Steel's 18-8 Bright Annealed Stainless prove it! This brilliant, lustrous stainless helps cut production costs by eliminating intermediate steps in polishing and finishing. And the mirror-like beauty of Wallingford's 18-8 Bright Annealed is more than just skin deep. It's there to stay — edge to edge, surface to surface. It's available now — up to 15" wide, from .005 to .070 gage.

See how this highly-ductile, corrosion resistant stainless can cut your production costs — contribute new sales appeal to your products. Write today for your free sample and data sheet. Factory trained sales-engineers are available. They will gladly discuss your particular application with you. Address all inquiries to 401 Valley St., Wallingford, Connecticut.

THE WALLINGFORD STEEL CO.

SINCE 1922

WALLINGFORD, CONNECTICUT, U.S.A.

LOW CARBON • HIGH CARBON
ALLOY • STAINLESS • STRIP and TUBING

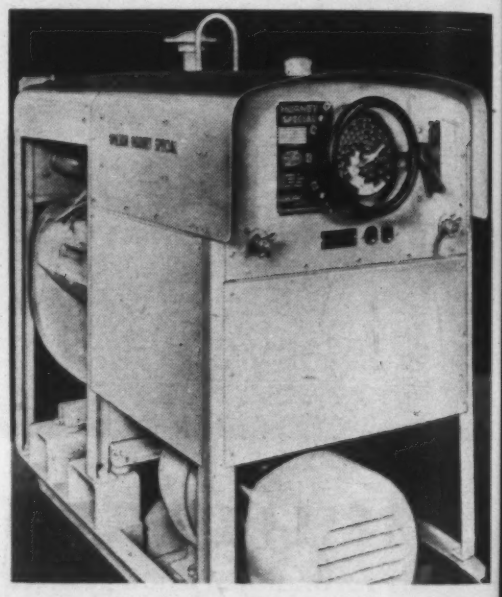
New Materials and Equipment

Brooklyn 6, N. Y. The stand permits foot-lever operation and makes the small welder an efficient stationary model.

The portable welder was described in MATERIALS & METHODS, Sept. 1949, p. 112.

Arc Welder

A 200-amp. Hornet "Special" arc welder is being offered by *Air Reduction Sales Co.*, 60 E. 42 St., New York 17. A compact 36A generator and a 4-cylinder, 31-h.p.,



Shown here is the new 200-amp. arc welder manufactured by Air Reduction.

air-cooled Wisconsin engine are combined in this new machine.

The 36A generator, built as a two-bearing unit, has a welding range from 40 amp. at 20 v. to 250 amp. at 40 v. The welder measures 58½ by 25⅝ by 47 in. and weighs 825 lb.

Joining

Thermosetting Adhesive

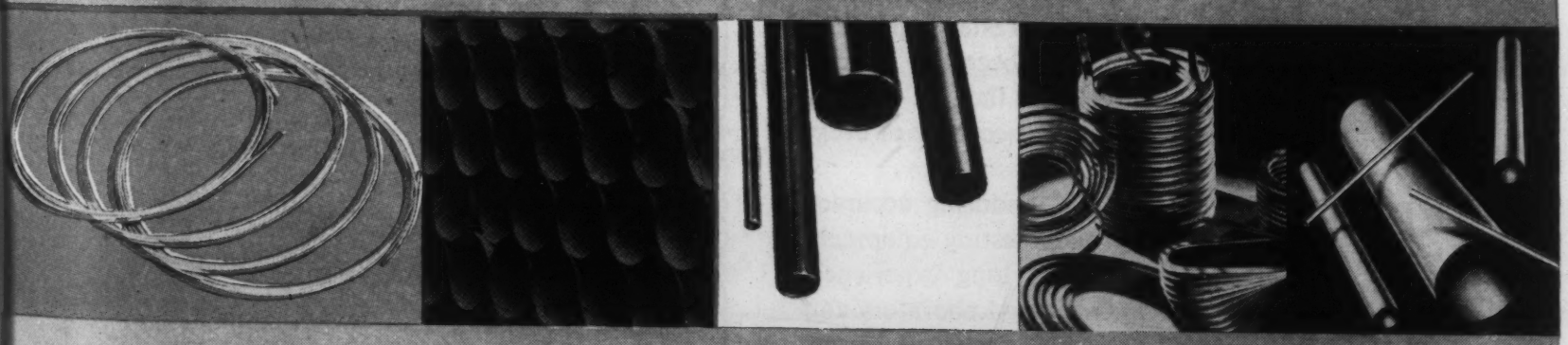
A new adhesive which joins metals, glass, ceramics, plastics, wood and other rigid materials to themselves and to each other has been developed by *Armstrong Products Co.*, 396 N. Broadway, Burket, Ind. Known as Armstrong's Adhesive A-1, this thermo-setting resin compound is often stronger than the material bonded.

The resin mixture contains no volatile solvent and does not shrink or swell upon hardening. For this reason, materials to be bonded can be assembled immediately after application of the adhesive, and the resin

TRENTWELD TUBING DOES IT BETTER!

Whatever your tubing requirements may be, investigate TRENTWELD. Made in a *tube* mill by *tube* experts, TRENTWELD is machine-formed, machine-welded and machine-sized for uniformity. Tested cold rolled stainless sheets are completely fused into finished tubing *without* added rod metal. Developed by Trent specialists, this method results in tubing that is metallurgically correct, and has a uniform section . . . with no zone of weakness for corrosion to attack.

Our manufacturing methods and modern facilities permit us to supply TRENTWELD Tubing in a complete range of tube sizes from ⅛" to 22" diameter in long lengths or up to 30" diameter in shorter lengths. Whatever your Industry,



there's TRENTWELD Tubing to fit your design. Our years of experience as tube specialists is at your call. Write us full details about your application.

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• Immediately a "ROCKWELL" or "TUKON" Hardness Tester is put into use, its purchase price becomes its least important feature. From then on the only measure of value is the accuracy of every test made.

The dependable, enduring accuracy of all Wilson hardness testing equipment is assured by Wilson's long experience, the Wilson Standardizing Laboratory and Wilson Field Service Engineers. In terms of hardness testing service, Wilson offers you most for every dollar you invest.

Write for Catalog RT-46 on the "ROCKWELL" Hardness Tester and Bulletin DH-7 on microhardness testing with the "TUKON" Tester.

BRALE is the only diamond indenter made to Wilson's precision standards for use on "ROCKWELL" Hardness Testers and "ROCKWELL" Superficial Hardness Testers.

WILSON
MECHANICAL INSTRUMENT CO., INC.
AN ASSOCIATE COMPANY OF AMERICAN CHAIN & CABLE COMPANY, INC.
230-E PARK AVENUE, NEW YORK 17, N. Y.

New Materials and Equipment

can also be used as a gap-filling material.

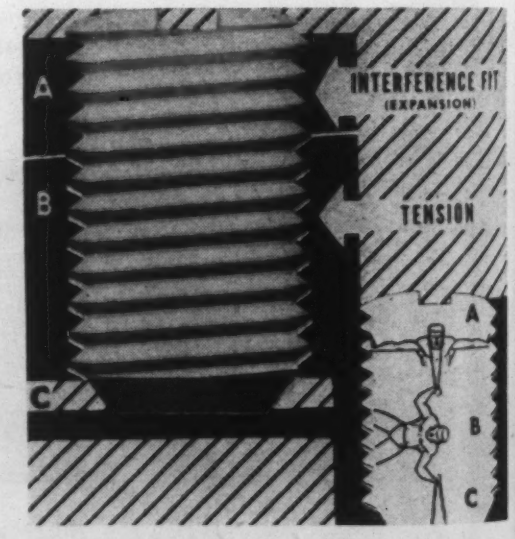
Adhesive A-1 starts to cure as soon as the activator is mixed with the resin composition. At room temperature, the material will develop about half its full strength overnight with Activator "A" and in 24 to 36 hr. with Activator "B". A temperature of 100 F makes curing twice as rapid, and for many applications, cures can be made in 1 to 2 hr. at 200 F.

Among proved applications for the new adhesive are: bonding of aluminum alloy spacers to steel disks in magnetic fluid clutches which operate up to 200 F; repair of broken aluminum castings and ceramic materials; and bonding of plastic sheet materials to aluminum and steel.

Self-Locking Set Screw

A self-locking set screw and adjusting screw, called Zip-Grip and featuring triple-locking action, has been announced by *Set Screw & Manufacturing Co.*, Bartlett, Ill.

Locking action is obtained by a combination of interference fit, tension, and locking of the set screw against the lower part of



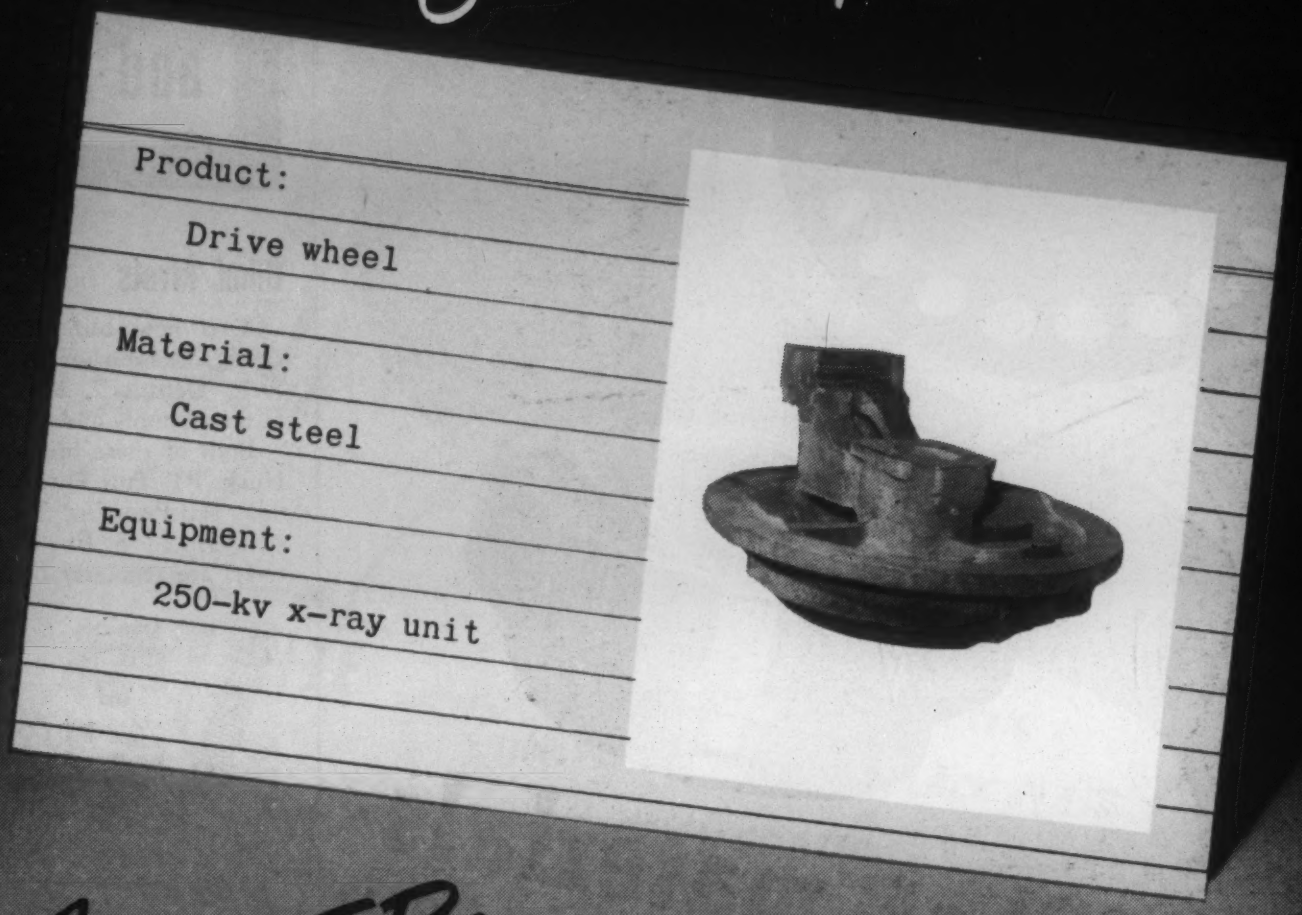
Triple locking action is claimed for the Zip-Grip screw.

the Zip-Grip screw. No lock nuts, wires, impinging locking screws, or deformed or riveted threads are involved.

Advantages claimed for the new screw are: (1) reduction of production costs on tapping operations, as no closer fit than Class Two is required and extra tapping for counter-locking and extra set screws is eliminated; (2) increased assembly speed, because no outside locking devices have to be adjusted; and (3) improved performance due to elimination of loosening in vibration applications and increased speed of adjustment for regulating screw applications.

The new screws are available in all metals, including soft or hard steel (case-hardened or heat treated), stainless steel, brass, bronze or aluminum.

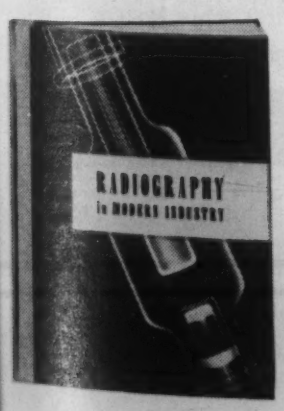
What's the right X-Ray film?



ANSWER:

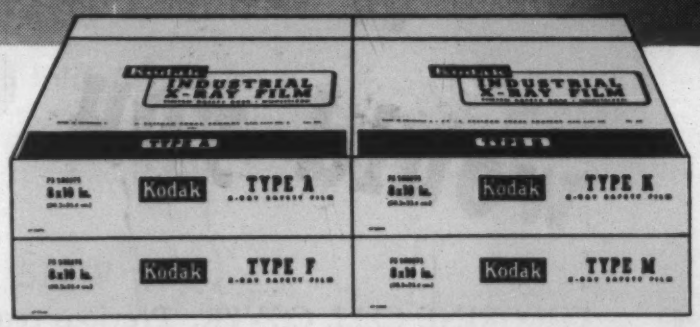
KODAK INDUSTRIAL X-RAY FILM, TYPE F

Because the equipment had only moderate power and section thicknesses up to 3¼ inches were to be examined, the radiographer chose Kodak Industrial X-ray Film, Type F, exposed with Kodak Industrial X-ray Intensifying Screens. This film is designed for use with fluorescent screens to provide maximum speed. The combination is essential in boosting equipment capacity to handle a heavy job like this. And, since the examination is for gross defects, speed is more important than sensitivity to very fine detail.



RADIOGRAPHY IN MODERN INDUSTRY

A wealth of invaluable data on radiographic principles, practice, and technics. Profusely illustrated with photographs, colorful drawings, diagrams, and charts. Get your copy from your local x-ray dealer—price $3.



A TYPE OF FILM FOR EVERY PROBLEM

To provide the recording medium best suited to any combination of radiographic factors, Kodak produces four types of industrial x-ray film.

Type F gives the highest available speed and contrast when exposed with calcium tungstate intensifying screens. Has wide latitude with either x-rays or gamma rays, exposed directly or with lead screens.

Type M provides high contrast and exceptional detail under direct exposure or with lead-foil screens. It has extra-fine grain, and speed is adequate for radiography of light alloys at moderate kilovoltages and for much million-volt work.

Type A offers high contrast with about three times the speed of Type M, but with slightly more graininess. Used direct or with lead-foil screens for study of light alloys at lower kilovoltages, and of heavier steel parts at 1,000 kv and with gamma rays.

Type K has medium contrast with high speed. For gamma ray and x-ray work where highest possible speed is needed at available kilovoltage without use of intensifying screens.

EASTMAN KODAK COMPANY
X-ray Division · Rochester 4, N. Y.

"Kodak" is a trade-mark

Radiography

another important function of photography

Kodak

What materials would you choose?

1. CHLORINE CELL COVER: Previous cement covers deteriorated rapidly, gave rise to contamination in vorce cell, with consequent increased current and maintenance costs. Now made of material that combines high strength with superior electrical and chemical resistance to give longer life, cleaner product. What material?

2. BATTERY VENT CAP: Permits gases to escape from auto battery without letting acids out. Must be low in cost, resistant to acids. Should permit high molding rates, easy assembly and cementing of two halves. What material would you try first?

Answers: No. 1—Ace Molded Hard Rubber greatly increased life of vorce cell covers, may do same for your designs. No. 2—Try Ace Parsan (polystyrene) *first* for any job similar to this Ace-molded vent cap.

Yes, sometimes it's hard rubber, sometimes one of the other plastics that's best. Ace, with many hard rubber and plastic compounds to choose from, is fully equipped to supply whatever you need.

Ask for ACE Handbook

ACE AMERICAN HARD RUBBER COMPANY

HARD RUBBER and PLASTICS

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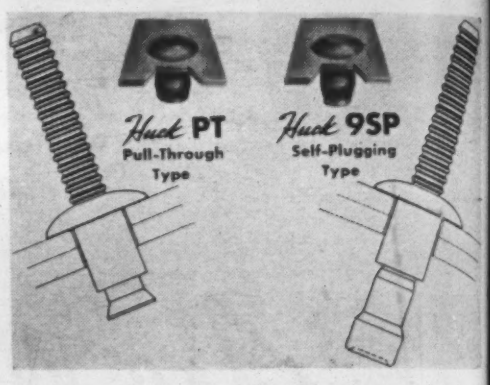
New Materials and Equipment

Blind Rivets

Two new blind rivets available from *Huck Manufacturing Co.*, 2480 Bellevue Ave., Detroit 7, Mich., are said to offer faster assembly and lower cost.

Both of these blind rivets, designated as Huck PT Pull-Through Type and Huck 9SP Self-Plugging Type, are available in 1/8-, 5/32-, 3/16- and 1/4-in. dia. Both rivets are regularly furnished in aluminum



Faster assembly and lower cost are claimed to result from use of these new Huck rivets.

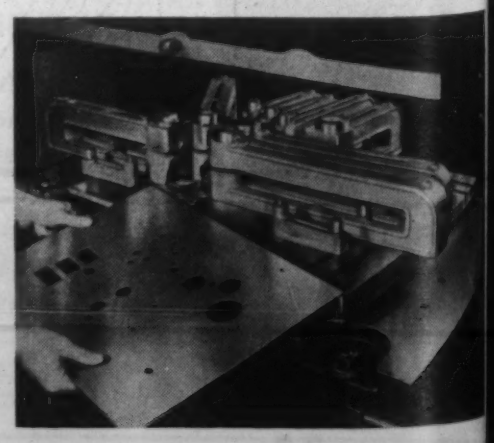
alloys or cadmium plated mild steel, with brazier or 100-deg. countersunk heads.

Fast, easy driving of these rivets is assured by large grip ranges, positive shank expansion, pull grooves in the pin tail to give positive driving, and special engineering features which prevent splitting of the sleeve during formation of the blind head.

Forming

Metal Perforating System

A system utilizing master templates for perforating and notching sheet metal has been announced by *Wales-Strippit Corp.*, North Tonawanda, N. Y. Designed for fast, efficient fabrication, this system eliminates expensive single-purpose dies. It is available



This Wales-Strippit set-up was used to perforate the many holes shown in the finished work in the foreground.

QUALITY
ALL THE WAY THROUGH

WEIRITE — HOT-DIP AND ELECTROLYTIC TIN PLATE, TIN MILL BLACK PLATE AND SPECIAL COATED MANUFACTURING TERNES

WEIRZIN — ELECTROLYTIC ZINC-COATED SHEETS AND STRIP

WEIRTON — HIGH-CARBON STRIP COLD-ROLLED SPRING STEEL

WEIRALEAD — LEAD ALLOY COATED SHEETS AND LONG TERNE SHEETS

WEIRCOLOY — GALVANIZED SHEETS

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Lacquered and Coated Products • Tie Plates • Structurals • Bars • Piling
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Superior

ROUND & SHAPED TUBING

(.010" to 5/8" O.D. Max.)

Available in:

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Stainless Steels:
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Nickel Alloys:
Nickel, "Monel", "K-Monel", "Inconel"

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UNLIMITED DESIGN POSSIBILITIES

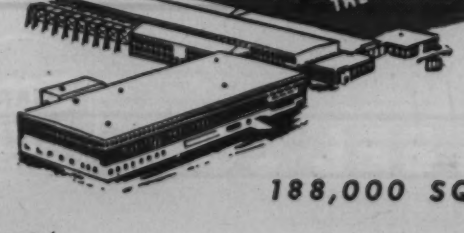
For the instrument maker, Superior furnishes tubing in cut, multiple or random lengths, shaped to "standard" specifications—or your specialized designs. Flat and elliptical ovals for bourdon springs can be produced in any analysis shown in the accompanying table.

Superior Shaped Tubing Specification and Tolerance Sheets list all the shapes and sizes for which tools are prepared and in stock. While the specification sheets are not available for general distribution, a Superior representative will gladly call at your office to review your dimensional, analysis and delivery requirements.

You are invited to make full use of this Superior service—your request will receive prompt attention.

Superior

THE BIG NAME IN SMALL TUBING (.010" TO 5/8" O.D. MAX.)



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188,000 SQ. FT. PRODUCING METAL TUBING

New Materials and Equipment

for both stamping presses and press brakes.

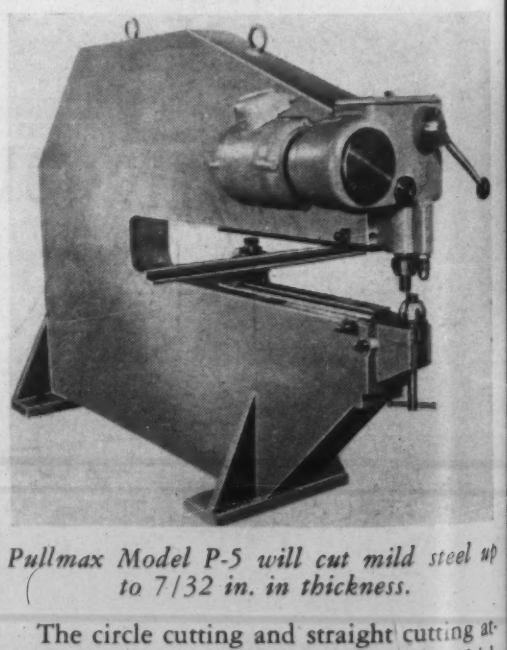
A master template, placed on the press bed, has pilot pin holes located over the entire surface area in the same pattern as the perforations in the finished piece of work. Set-up templates, marked with the operation number and punch size, are then placed on top of the master template to identify the pilot pin holes to be used in each operation. The number of operations on each part depends on the quantity, size and position of perforations. It is possible to reuse the same group of units on unlimited set-ups on the master template.

Previously, it was generally necessary to design and custom-build a new "fixed" die for each pattern. Now, however, a group of Wales units can be set up in unlimited patterns and put into operation the same day a pattern is released for production. Engineering changes requiring new hole locations can be made by merely drilling a new pilot pin position on the master template.

Sheet Cutting Machine

A sheet cutting machine which has an edge cutting capacity from finest gages up to 7/32 in. in mild steel has been introduced by the *American Pullmax Co., Inc.*, 2627 N. Western Ave., Chicago 47, Ill.

This machine, Model P-5, is capable of straight, circular and irregular cutting, in addition to folding, beading and slotting. It will cut circles up to 40 in. in dia. and has a throat depth of 42 in.



Pullmax Model P-5 will cut mild steel up to 7/32 in. in thickness.

The circle cutting and straight cutting attachments have quick-locking devices which allow size changes in one movement for faster operation and production work. The mechanism is entirely enclosed and operating in an oil bath.

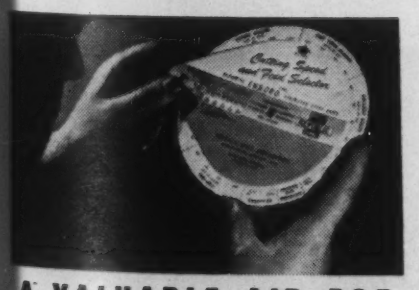
a Fountain Favorite...

POURS THROUGH SANITARY VALVES OF *Free-Machining* ENDURO STAINLESS STEEL

There's no compromise with quality when it comes to protecting the taste and purity of America's favorite soft drinks. That's why sanitary, easy-to-clean, corrosion-resistant ENDURO Stainless Steel (Type 303) is used for these fountain dispenser valve parts.

From a manufacturing standpoint, there are other reasons, too, for the specification of ENDURO Cold Finished Bars. Close tolerances . . . accuracy of section . . . uniform soundness . . . fine surface finish . . . and UNIFORMLY HIGH MACHINABILITY . . . all combine to keep down unit costs and reject losses.

Whenever you need top machinability plus one or more of the other qualities which only stainless steel can provide, remember to specify Republic ENDURO Stainless Steel Bars—cold finished or hot rolled—and wire. Available for prompt delivery. Write us *today.*



A VALUABLE AID FOR MACHINISTS

It's a handy Speed and Feed Selector to help you in machining stainless steel. Send for one TODAY.. it's FREE.

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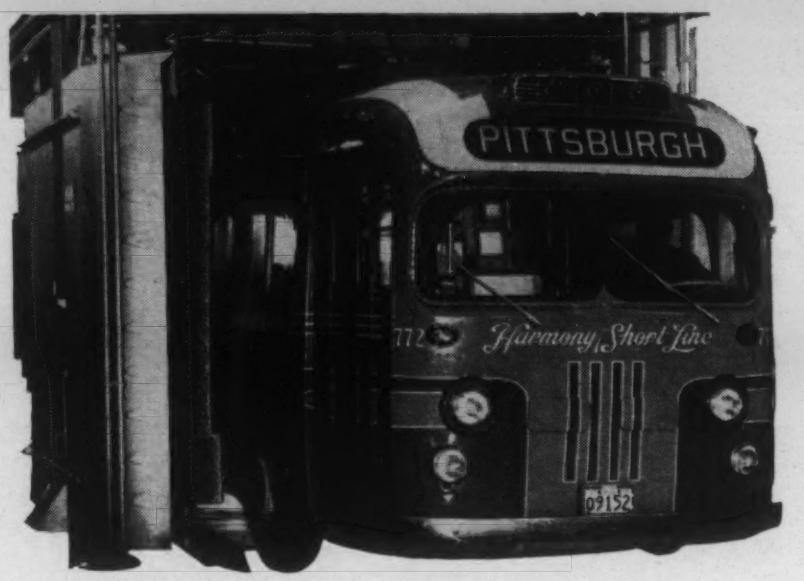
Republic ENDURO FREE-MACHINING STAINLESS STEEL

REPUBLIC STEEL

Other Republic Products include Carbon and Alloy Steels—Pipe, Sheets, Strip, Plates, Bars, Wire, Pig Iron, Bolts and Nuts, Tubing



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Cites 3 Advantages

OF FULLERGRIPT BRUSHES

Now Standard Equipment on all Whiting Bus Washers

Whiting engineers have standardized on Fullergript brushes with plastic cores for their bus washers because (1) greater control over the density of bristles may be maintained, (2) the bristles stay in the brush and (3) when replacements are necessary, they may be made in a matter of minutes instead of hours. Small segments of the Fullergript strip may be replaced as they wear down. The brush material is wire-anchored under great pressure inside a rigid, rust-resistant metal channel.

Whiting Bus Washers, which thoroughly clean a bus in less than a minute, are helping many transportation lines to build good customer relations by meeting the public's growing demand for clean, attractive equipment. The Whiting Corporation, like scores of other companies in a wide variety of industries, has found that it pays to standardize on Fullergript. Have *you* investigated the time and cost-saving possibilities of Fullergript for your plant? For information write to...

FULLERGRIPT The FULLER BRUSH CO.

INDUSTRIAL DIVISION, 3636 MAIN ST., HARTFORD 2, CONN.

New Materials and Equipment

Melting and Molding

Plastics Molding Press

A 2-oz. injection press designed for molding practically all thermoplastics including nylon has been developed by *Van Dorn Iron Works Co.*, 2685 E. 79th St., Cleveland 4, Ohio. This press, Model H-200, has a capacity of about 12 lb. per hr., a maximum mold size of 8 by 10 in., and a casting area of 20 sq. in.

The press, which has a hopper capacity of 6 lb., maintains up to 180 operating cycles per hr. Injection plunger and toggle mechanism are operated by hydraulic pressure developed by a pump driven by a 3-h.p. electric motor. The machine is easily operated by semi-skilled help.

Plastic Melter

A melter which is capable of melting Plastiflex at a rate of from 1 to 6 lb. per min. in a continuous flow is available from *Calresin Corp.*, 8564 Washington Blvd., Culver City, Calf.

The Magnaflow melter can be set at any pouring temperature desired within the 300 to 400 F range, and it is said to eliminate the danger of overheating and burning. Although the melting time required for vinyl-base hot melt material varies from 2

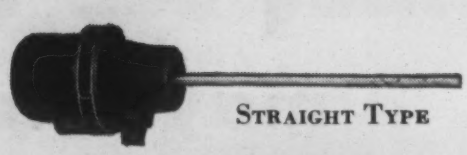
A 150-lb. drum of Plastiflex is being emptied into the 200-lb. capacity hopper of the Magnaflow melter.

to 4 hr., the Magnaflow starts delivery of melted material in approximately 8 min. at the designated temperature and flow-rate. The hopper can store up to 200 lb. of granulated material.

The machine will be available in two

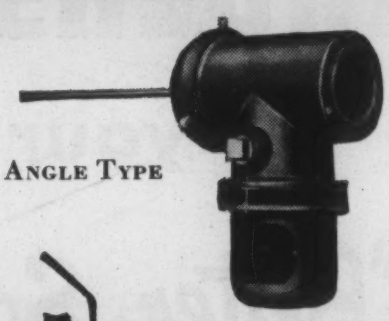
THE HOTTEST NEWS IN FLAME SAFETY

. . THE ALL-NEW PROTECTOGLO!



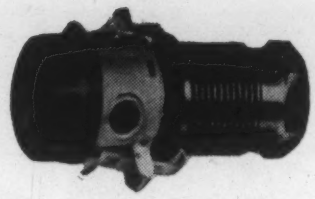
STRAIGHT TYPE

FLAME-ELECTRODE RECTIFIERS *for non-luminous gas*



ANGLE TYPE

FLAME - RECTIFIER PILOT—*a combined flame-electrode rectifier and gas pilot burner assembly*



PHOTOCELL RECTIFIER *—is ideal detector unit for use with luminous flames*

AND there are a lot of good reasons why the all-new Protectoglo is receiving such an enthusiastic reception. In addition to the versatility demonstrated by the availability of the four different flame detector units pictured above, the new Protectoglo boasts these outstanding features:

- *Automatic Self-Checking, without manual push-button, provides "Safe-Start" Circuit and safeguards against component failure.*
- *Positive Flame Failure Protection through the* rectification principle *which eliminates unsafe conditions due to grounding . . . does not rely on flame conductivity or resistance.*
- *Expensive shielded cable not required.*
- *Plug-In Timer is optional for purge timing.*
- *Relite is possible without additional relays.*

BROWN INSTRUMENTS — WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

Call in your local Honeywell engineer for detailed information . . . or write for a copy of Specification Sheet 526.

The All-New Protectoglo Is Now Available For Immediate Delivery!

MINNEAPOLIS-HONEYWELL REGULATOR CO.
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Offices in 73 principal cities of the United States, Canada and throughout the world

Honeywell — *Advanced Instrumentation* — BROWN
FOR METAL PROCESSING

You too,
may find
INGERSOLL
your
"Better Source"
for
these three
Special Steels

We Invite Your Inquiries

INGERSOLL STEEL DIVISION
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310 South Michigan Avenue, Chicago 4, Illinois
Plants: Chicago, Illinois; New Castle, Indiana; Kalamazoo, Michigan

ENGINEERING B-W PRODUCTION

New Materials and Equipment

standard models, with custom-built models obtainable on special order.

Inspection and Control

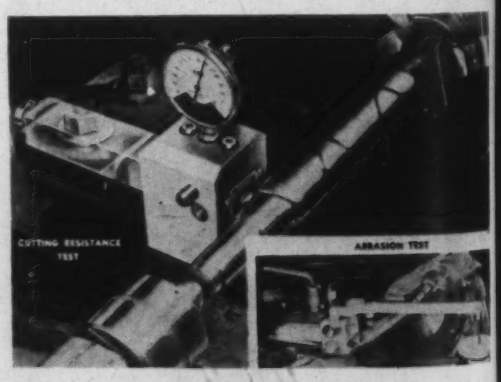
Machinability Tester

A simple device for measuring the machinability of metals has been announced by *Vanton Equipment Corp.*, Empire State Bldg., New York City.

The M.S.E. Schlesinger Machinability Tester makes it possible to establish a machinability index for any particular metal through a conventional cutting operation such as turning or planing. The index is called "Machining Effort," and is found by multiplying together two measured values called "Specific Cutting Resistance" and "Abrasion Factor."

The "Specific Cutting Resistance" is that resistance exerted by a material against the penetration of a standardized kind and shape of cutting tool for a standardized chip area. The dial indicator on this instrument reads directly in lb. per 0.001 sq. in. This measurement is believed to be a direct indication of tangential cutting force only, and therefore directly related to power consumption of the machine tool.

The "Abrasion Factor" indicates the actual wearing effect of a work material on a cutting tool. This effect is determined by measuring the abraded flat on a standardized 10-mm. test ball brought into contact with the work material under a known pressure and for a given duration of time.



The M.S.E. Schlesinger Machinability Tester measures both cutting resistance and abrasiveness of the material.

The machinability index obtained by this method is claimed to be reproducible anywhere under the same general conditions. In addition to establishing machinability ratings for work materials, this unit makes it possible to standardize related factors concerning cutting tools and cutting fluids.

The complete machinability tester unit includes: cutting resistance dynamometer

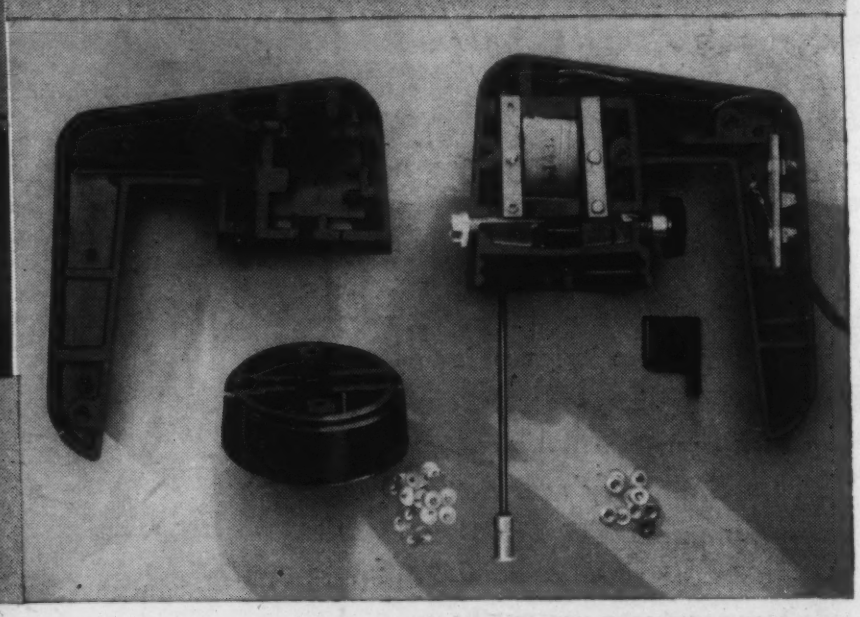
It pays to use your custom molder's know-how

— and give your sales a shot in the arm

No. 13 in a series on Plastics Skill at Work...

PRODUCT: Electric Sprayer for Household Use
CUSTOMER: Handicraft Division of Burgess Battery Co.
MOLDER: Eclipse Manufacturing Co.
MATERIAL: Durez phenolic housing, handle, and fittings.

BEFORE AND AFTER comparison shows enormously increased sales appeal obtained in redesign of Burgess Battery Company's "Vibro-Sprayer." Durez plastic enabled designers to suggest simplicity and ease of use in exterior lines of the unit.



CUT-AWAY reveals complicated shapes with bosses and recesses obtained by the molder in single forming operation. Assembly jigs formerly required are no longer needed. Durez is self-insulating, an added time-saver.

Front and center display in retail stores today is worth a lot of money, and the Handicraft Division of Burgess Battery Company is among the manufacturers who are using Durez plastics to get more of it.

Taking a completely fresh approach to the matter of exterior shape, this company evolved a compact electric sprayer design that suggests (and has) the efficiency of pistol-trigger operation. People just naturally reach for it, buy it, and take it home to save time in painting, insect control, disinfecting, and other household, shop and farm spraying jobs.

The molding process, and the engineering skill of an experienced custom molder, made it possible to produce this new shape at mass-market cost.

Whenever you want to reawaken interest in your products, consider *first* the inherent advantages of molded Durez. Durez allows your designers the freedom of imagination they need, permits the faster production you will want. It has excellent mechanical, electrical, and chemical properties, and comes from the mold with a permanent lustrous finish.

Durez field technicians are always on call for productive consultation with you and your molder.

A hit with plastics users everywhere is the handy "Durez Check-Chart." Write for yours. Durez Plastics & Chemicals, Inc., 141 Walck Rd., N. Tonawanda, N. Y.

DUREZ

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
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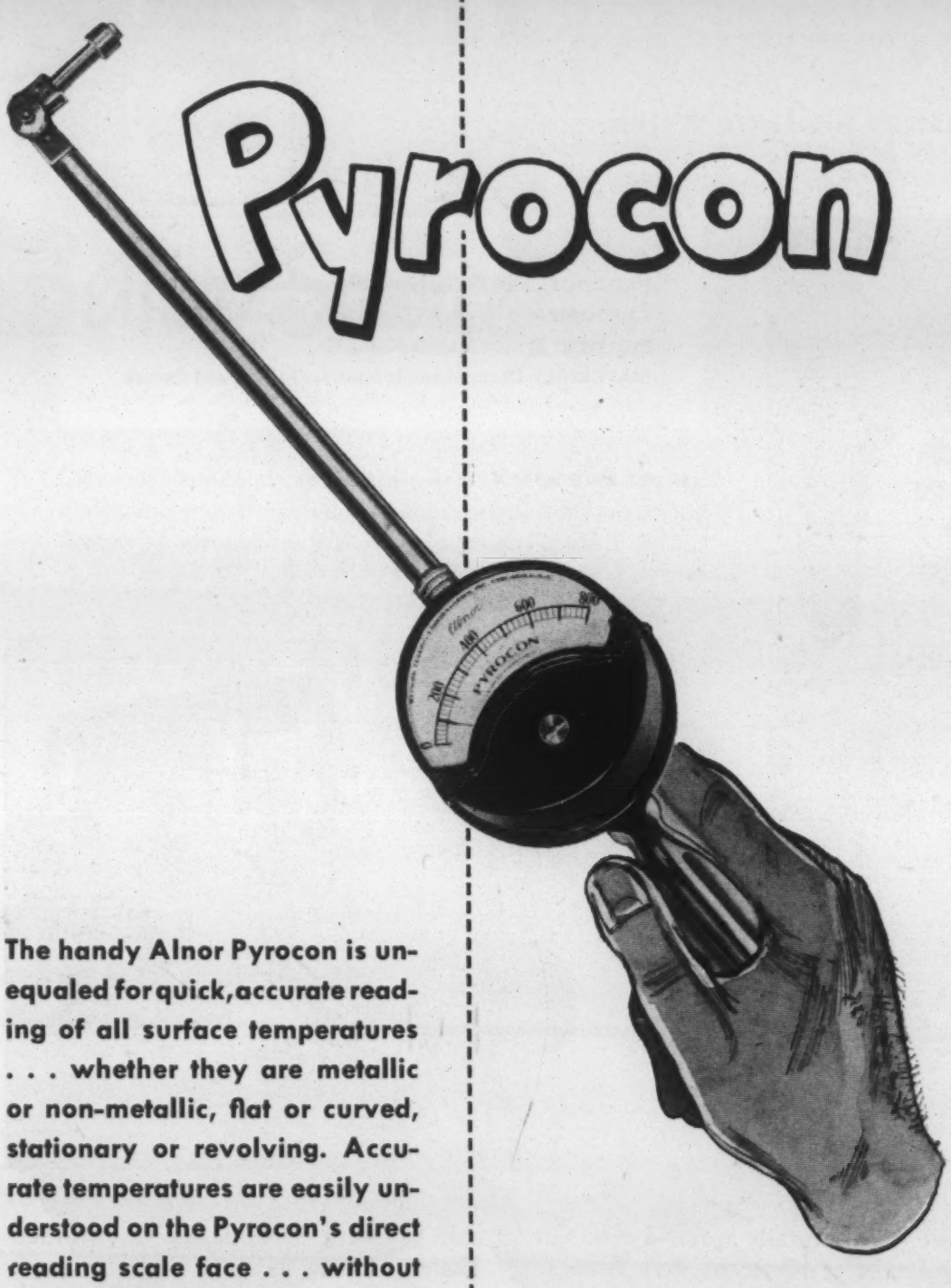
PHENOLIC PLASTICS THAT FIT THE JOB

Take surface temperatures quickly, accurately... with the

Pyrocon



The handy Alnor Pyrocon is unequaled for quick, accurate reading of all surface temperatures . . . whether they are metallic or non-metallic, flat or curved, stationary or revolving. Accurate temperatures are easily understood on the Pyrocon's direct reading scale face . . . without interpolation or need of conversion tables. A wide selection of thermocouples and extension arms permits adaptation to many types of service. For complete details and prices, send for Bulletin No. 4257. Illinois Testing Laboratories Inc., Room 522, 420 N. LaSalle Street, Chicago 10, Ill.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

New Materials and Equipment

with direct-reading indicator, including calibration beam and 11 standard weights; abrasiveness attachment with magnifier and ½ gross 10-mm. test balls; set of eight standardized carbide-tipped cutting tools; universal grinding fixture for maintaining all tool angles as specified; and nose grinding fixture for maintaining accurate nose radius of all tools.

Surface Reproduction

A special liquid casting plastic which can be used to check new or worn machined surfaces of various mechanical parts is available in kits supplied by *Marco Chemicals, Inc.*, Sewaren, N. J.

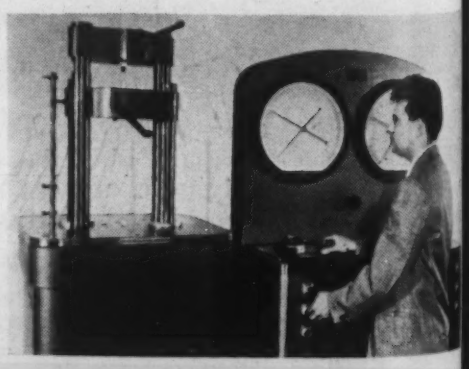
Each kit contains a pint of casting resin and the proper amount of catalyst which, combined with the resin, will cause it to solidify in about 15 min. The catalyzed plastic resin is poured against the surface to be checked and removed when hard.

The cast plastic provides an accurate and permanent record of the surface condition of the machined piece. A green-colored resin is used, as it has been found that surface variations are more easily detected against the colored background.

Universal Testing Machine

An improved universal testing machine, Model 60-8, having 60,000-lb. capacity with two ranges has been announced by the *Baldwin Locomotive Works*, Philadelphia 42, Pa.

The 60,000-lb. range of the low-cost tester is graduated in 100-lb. units on a 16-in. indicator dial, and the 12,000-lb. range is graduated in 20-lb. units. Loading controls give infinitely variable speed between 0 and 2 per min.



This Baldwin tester has a capacity of 60,000 lb. with two ranges.

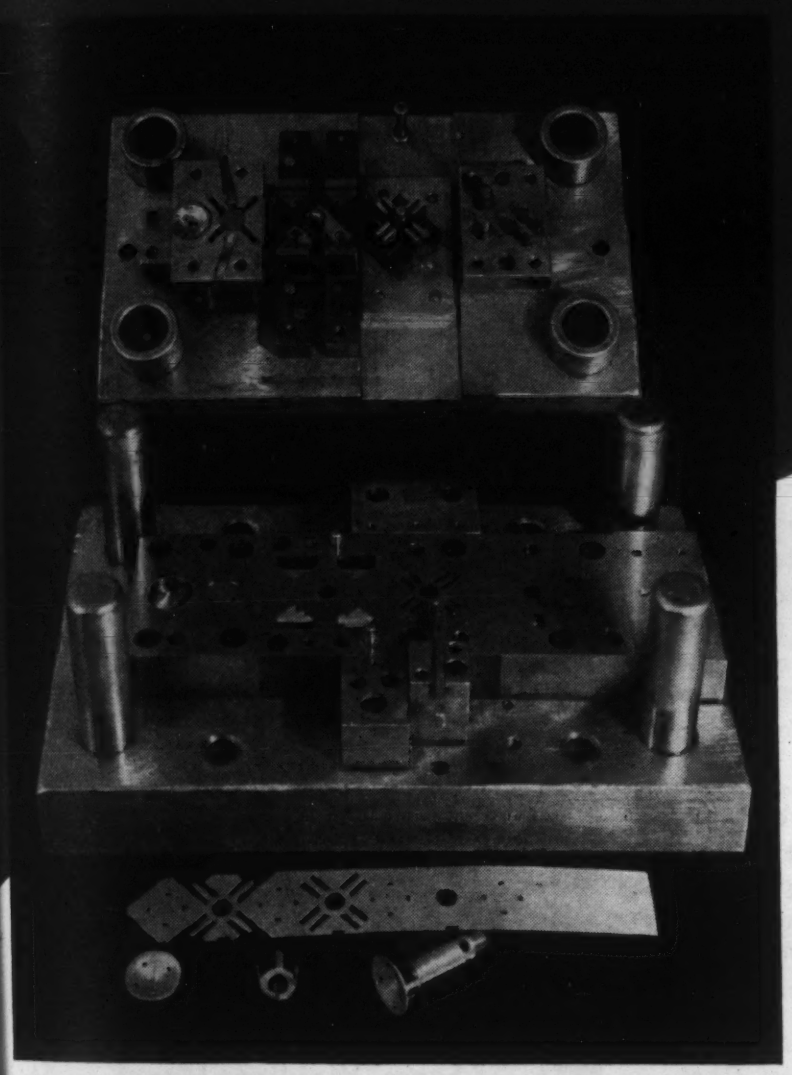
The machine is designed with hydraulic loading unit separate from the indicating and control unit, thus isolating recoil from breaking specimens and allowing adjustment of maximum or lazy hands with minimum drag. Rigid two-column design makes specimens accessible and simplifies observation

A-H5

(5 PCT CHROME AIR-HARDENING)

A Toolroom Favorite on 5 counts

1. Air-hardening for safety.
2. Good wear-resistance.
3. Good toughness.
4. Excellent resistance to deformation.
5. Easy to machine.

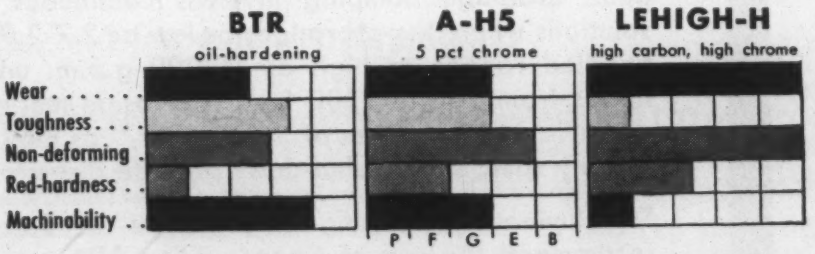


"A-H5 always meets or exceeds our expectations . . ."

This comment comes from the chief engineer of Day and Night Division, Affiliated Gas Equipment, Inc., in Monrovia, California. This company makes a modern line of gas, space and water heaters for home and commercial uses. The die shown is used to pierce, blank and form burner canopies from .0235-in. stainless-steel strip. With all its parts made of A-H5 except the punches (they are Lehigh H), this progressive die is still going strong after producing several hundred thousand pieces, samples of which are shown in the foreground.

There's plenty of versatility in this 5 pct chrome, air-hardening tool steel. And it's economical, too, often replacing more expensive grades.

A-H5 is a general-purpose steel that fits in between the standard oil-hardening steels (such as Bethlehem's BTR) and the high-carbon, high-chrome tool steels like Lehigh H (another Bethlehem champion). Here's a quick comparison of the properties of all three:



(Poor, Fair, Good, Excellent, Best)

Use A-H5 for a variety of dies, punches, blanking tools, cold-forming dies, master tools, gages, and the like. Give it a thorough trial and you'll be sold on having it in your toolroom to stay. Let the nearest Bethlehem sales office or tool-steel distributor give you complete information. Quick delivery from our mill depot or local distributor's stock.

HEAT-TREATMENT OF A-H5

Typical Analysis:	C	Mn	Cr	Mo	V
	1.00	0.60	5.25	1.10	0.25

Annealing: Pack, heat to 1650 F, slow furnace-cool, Brinell 212 max

Preheating: 1200 to 1250 F, prior to hardening

Hardening: 1775 F, air-quench

Tempering: 350 to 400 F, Rockwell C 60 to 62

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation

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BETHLEHEM STEEL

SUPERSONIC TESTED

Bethlehem Tool Steel

COOPER ALLOY

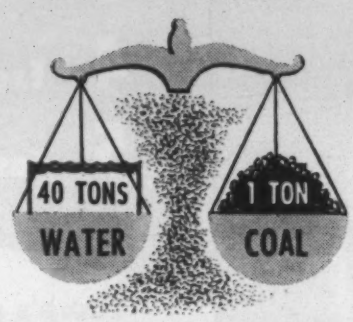
NEWSCAST

PUBLISHED BY THE COOPER ALLOY FOUNDRY CO., HILLSIDE, N. J.

FORTY TONS OF WATER FOR EVERY TON OF COAL

PUMPING CONDITIONS IN ANTHRACITE MINING DEMAND THE BEST IN MATERIALS AND EQUIPMENT

For every ton of anthacite coal mined, almost forty tons of water have to be removed. Since annual production approximates 45,000,000 tons of coal, the magnitude of the pumping problems connected with the removal of water by the billions of tons is staggering.



According to engineers at Barrett-Haentjens and Co., Hazleton, Pa., leading designers and manufacturers of centrifugal pumps, pumping conditions encountered in anthracite mining present a constant challenge to mine operators and equipment designers; for not only must the equipment be designed to resist corrosion, as in mine drainage work, but it must also be able to withstand the abrasion encountered in coal preparation.

Mine drainage pumping involves continuous operation in solutions where the pH ranges as low as 2.7-2.9. The volume handled ranges as high as 10,000 g.p.m. under pumping heads from 200 to 1200 feet. Corrosion means costly shut-down . . . and in times of "highwater," as may occur during a rainy spell, such a shut-down may be disastrous.

To eliminate this danger, engineers at Barrett-Haentjens recommend the use of Cooper Alloy 19A, a stainless steel alloy containing 28% Cr. and 3% Ni. Laboratory and field tests have demonstrated the excellent service to be obtained from the use of this alloy, and mine owners are becoming convinced that the higher initial cost is far outweighed by the long range economies effected.

The most severe pumping conditions, however, occur when this acidulous mine water is used in the coal cleaning or preparation process. In addition to the acid, pumps must handle coal, slate, rock and dirt, and in some systems, sand. Specially built Hazleton type "CB" solids handling pumps provide satisfactory service in this application, thanks to the excellence of the design and the wise use of Cooper Alloy 19A for impellers and wearing rings. Frequently, the entire pump, including the huge casing is cast in this corrosion and abrasion resistant alloy to assure guaranteed service.

AVAILABLE UPON REQUEST technical data chart giving Comparative Resistance of cast Stainless, Nickel, and Monel in a wide variety of corrosive media.

The COOPER ALLOY Foundry Co.....leading producer of Stainless Steel VALVES • FITTINGS • CASTINGS

rapid means of fabricating light- and medium-gage metal, its use on galvanized steel and other coated metals has not gained wide use because of lack of information on the most effective welding conditions. In the paper "Spot Welding Galvanized Steel," by M. L. Begeman, M. L. Hipple and L. Cullum, Jr., the factors involved in commercial welding of galvanized steel are discussed, and suggested welding procedure is outlined.

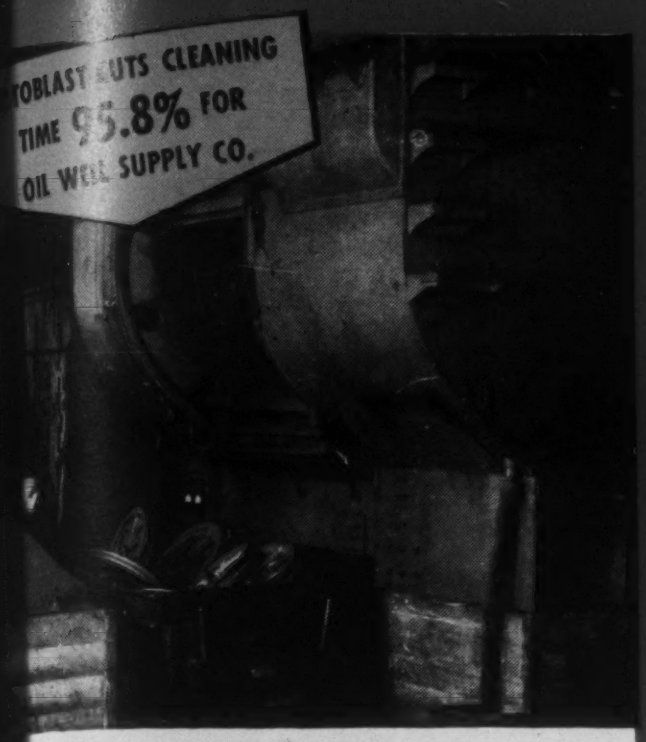
Specifically, the authors investigated the problems involved in spot welding of 20- and 22-gage galvanized steel of various thickness coatings. They found among other things that (1) weld strength increases proportionately with an increase in welding current; (2) weld strength increases as weld period increases from the minimum of 3 cycles (1/20 sec.) to 15 cycles (¼ sec.)—weld strength appears to become constant when using weld periods above 15 cycles; and (3) at low welding current an increase in electrode tip pressure greatly decreases weld strength and at high welding currents weld strength is approximately constant for all electrode tip pressures.

Finally, the application of refrigeration to tip cooling was studied and found to be not too practical because of the high installation and maintenance costs and the negligible increase in strength.

Seam Welding Monel to Steel

Welding two dissimilar metals such as Monel and steel presents many problems not encountered in welding identical metals. E. F. Nippes, A. E. Pfluger and G. M. Slaughter in their paper "Seam Welding Monel Metal to Steel" investigated the numerous problems involved and arrived at what they believe are the optimum welding conditions for this combination of materials.

A study was made of welding Monel to low-carbon steel in the 0.062-in. gage. It was found that for the weld times investigated fusion of both Monel and steel led to porosity and cracking in the weld zone. To avoid these defects, welds were made with fusion occurring only in the Monel. The optimum conditions for producing these "braze" type welds were, therefore, worked out. The strengths of welds made by this method exceeded those of seam welds of steel to steel.



Tests by Oil Well Supply Co. *show that* OBLAST *replaces five old-style tumbling mills,* ns *castings in 15 minutes, saves 95.8% on* ning *time.* Proof ROTOBLAST cleans faster!

Records kept by Yates American *chine Co. indicate ROTOBLAST saves $5080 labor, virtually ends downtime, cleans 18 times ster.* Proof ROTOBLAST cleans better!

Harris-Seybold reports *that their* OBLAST *room cuts cleaning time 66⅔%, re- four men for better jobs, saves $10,160 on lone.* Proof ROTOBLAST saves money!

HERE'S HOW YOU CAN SLASH blast cleaning costs with Pangborn ROTOBLAST*

USERS FIND ROTOBLAST SOLVES PROBLEM OF HIGH LABOR COSTS— SAVES MONEY CLEANING LARGE OR SMALL CASTINGS

IF YOU WANT TO SAVE on blast cleaning and get a faster, better job . . . modern Pangborn ROTOBLAST is a must for your cleaning room. Whether your foundry needs Barrels, Tables or Table-Rooms you'll find Pangborn has a standard model designed for your requirements.

Pangborn ROTOBLAST cleans faster because it throws more abrasive over a larger area with greater density . . . cleans better because it gets into small pockets, leaves no abrasive to damage machining equipment . . . cleans cheaper because it requires less horsepower, uses less manpower, needs less maintenance, eliminates need for air compressor!

GET THE FACTS! Find out how much money you can save with Pangborn ROTOBLAST. Bulletin 214 gives full details, technical information. Write for it today without cost or obligation. Address: PANGBORN CORPORATION, 1403 Pangborn Blvd., Hagerstown, Maryland.

Look to Pangborn for the Latest Developments In Blast Cleaning and Dust Control Equipment

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BLAST CLEANS CHEAPER with the right equipment for every job

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Soda Ash...Bicarbonate of Soda...Liquid
Chlorine...Dry Ice...Chlorine Dioxide...HTH
Products...Fused Alkali Products...Sodium
Chlorite Products...Carbonic Gas...Sodium
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That clean Mathieson Ammonia is quick on the take-off. A call from you to the nearest of Mathieson's 44 warehouses will bring "Super-Math" in a flash... and we do mean "super". It's pure—really pure—purged of moisture, non-condensable gases and other undesirables. Every cylinder and valve is thoroughly checked before quick-shipment to you. So if you need *pure* ammonia *promptly,* call Mathieson. A free 40-page booklet, "Ammonia in Metal Treating", is available on request. Mathieson Chemical Corporation, Mathieson Building, Baltimore 3, Maryland.

Let us recommend suitable equipment for your Thermocouple Connecting Jobs. Please send details of your application; or, write for Thermocouple Catalog or Panel Section 21G.

Select and Switch ANY NUMBER of Thermocouples to Pyrometers

The Connector Panel "Console" permits, thermocouples, regardless of number or location, to be selected and switched to one or more centrally located Pyrometers. The Plug and Jack method of connections provides positive contacts, affords greater flexibility and gives centralized control for interconnected pyrometric systems.

Built for "Engine Test" duty, the "Console" Panel Board, illustrated, has 160 plugs and jacks of thermocouple material. They provide flexibility for connecting five 16 point Recording Pyrometers.

Thermo ELECTRIC CO.
FAIR LAWN, N.J.

News Digest (continued)

Welding Nickel Alloys

Technical information on the welding, brazing and cutting of nickel, Monel, Inconel, "K" Monel, "Z" nickel and Inconel "X" by all applicable processes was given by K. M. Spicer in his paper "Joining Wrought Nickel and High-Nickel Alloys."

The high nickel alloys can be welded readily by all the processes common to other materials. Which method to use depends largely on the final service requirements. To avoid trouble and insure the results expected, careful attention must be given to the selection of the joining process, cleanliness, preparation of joints, fit-up, and testing procedures.

Nickel and high nickel alloys cannot be cut with conventional oxy-acetylene equipment. However, there are three other methods now available. One of these employs an attachment for the conventional cutting torch through which a finely divided iron powder is injected into the cutting-oxygen stream. Another process involves a hollow arc-welding electrode through which the cutting oxygen flows. And the third method uses a flux instead of the iron powder. This last method can be used on alloys containing less than approximately 30% nickel.

Analyzing Welding Arcs

A new instrument for analyzing metal transfer in arc welding has been developed by Battelle Memorial Institute and should prove to be a practical tool for studying arc behavior. R. C. McMaster, D. C. Martin and A. Leatherman described the instrument and the results of studies made with it in their paper "Analyzing Metal Transfer in Arc Welding." They found that the device was particularly well suited to studies of the influence of coating constituents on arc stability and metal arc transfer. The analyzer is a rugged piece of equipment involving no delicate components, and can therefore be used under production welding conditions. Studies were made with this instrument on the relative influence of electrode coating and core wire on various operating characteristics. In general, the results of the test indicated that the coating on the electrode has much greater influence than does the core wire.

Notch Sensitivity

Because of the great importance of notch sensitivity and its possible

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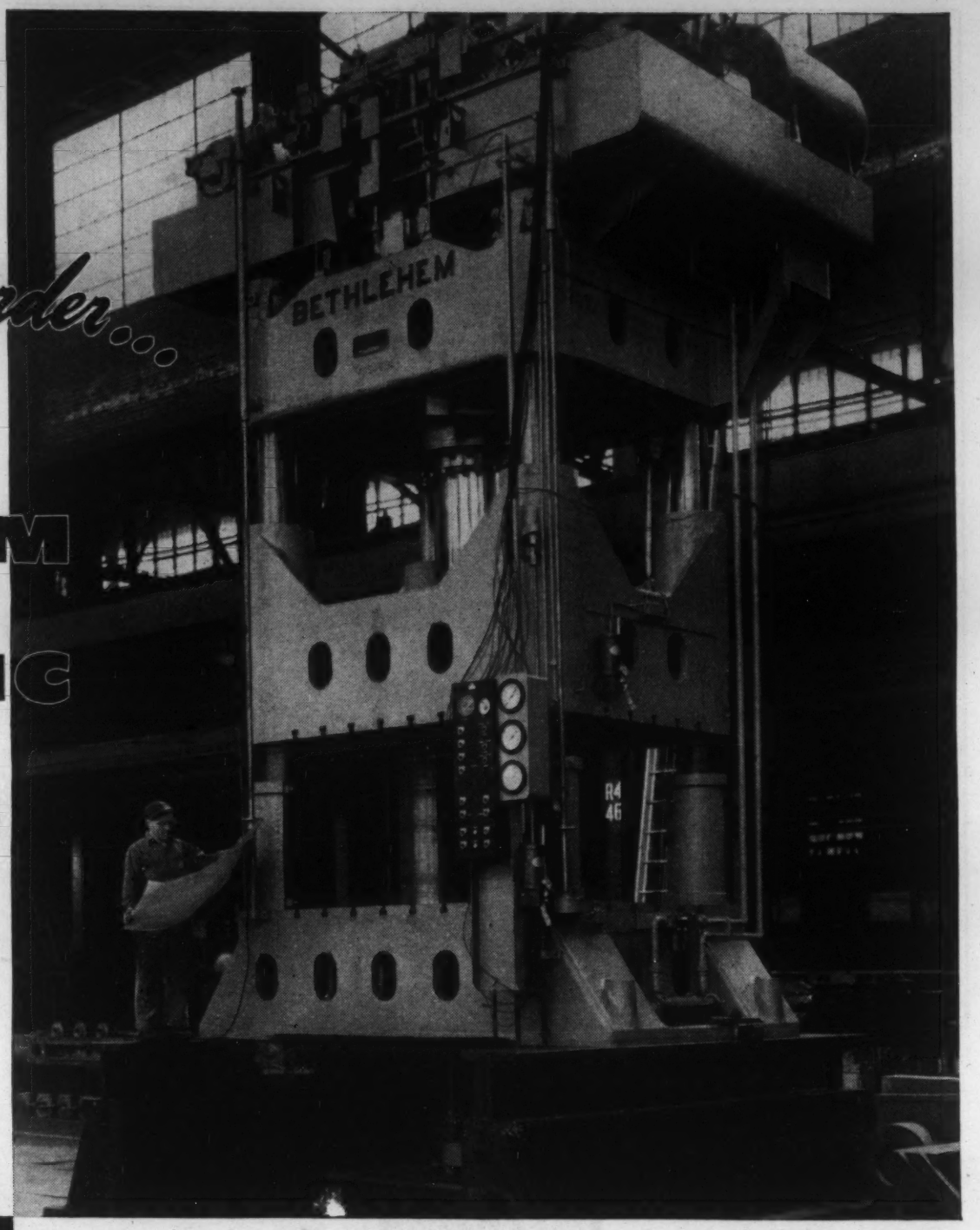
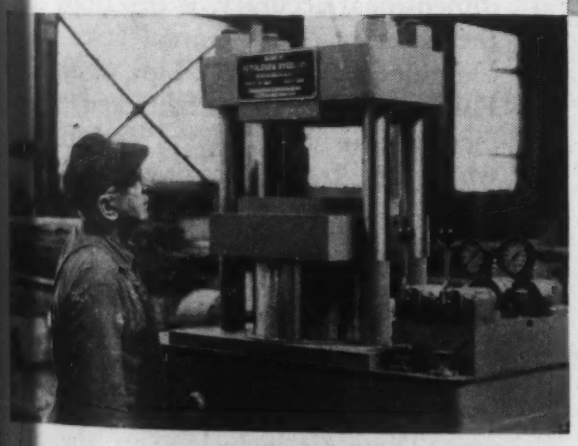
BETHLEHEM HYDRAULIC PRESSES





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Custom-Built
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Whether you need one press or a whole battery, we are equipped to do a full custom job for you . . . make the steel, do all the necessary forging, casting, machining, assembling, etc. We are not limited to a narrow range of sizes; on the contrary, our facilities enable us to produce both large and small units, and any size in between.

If the customer so specifies, his Bethlehem press can be furnished with self-contained or separate hydraulic power system, plus any desired accessories.

One of our engineers—a specialist in this field—will be glad to talk over your future requirements with you. Call him in; he's available whenever you need him. No obligation, of course.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

Producers of

Metal Powders

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AJAX

HIGH TENSILE MANGANESE BRONZE

- ***high in strength, toughness and corrosion resistance . . . . . .***
- ***long time favorite with manufacturers of marine fittings . . . . . .***
- ***leaves sand clean and bright—takes a mirror-like finish . . . . . .***
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connection with the failure of welded structures, a number of tests have been developed during the past few years to assess this property. C. F. Tipper has contributed much to the understanding of the problem with his paper "Correlation of Test Results," in which the various types of tests to determine transition temperature are evaluated. He concludes that the transition temperatures cannot be predicted from tensile test results, although low transition temperatures are associated with high values of reduction in area. Thus, some clue to the tendency to notch brittleness in structural mild steel can be obtained from the study of reduction in area results. He further concludes that at the present time, the appearance of fracture is the logical criterion of brittleness to adopt. While it is recognized that such a criterion is only qualitative, it is the common factor that influences all the mechanical properties and gives the most consistent figures for the determination of transition temperatures.

Vacuum Die Casting Equipment Gives High Dimensional Accuracy

A Dutch vacuum die casting process, which produces parts having high dimensional accuracy, is described in the *Foundry Trade Journal* (Oct. 6). Developed by E. M. H. Lips, of N. V. Phillips' Gloeilampenfabrieken, the method can be used to cast parts which are free of cavities under a high gas pressure, thus overcoming one of the main disadvantages of ordinary die casting processes.

In ordinary machines, the liquid metal is forced into the mold in such a way that some air is trapped and compressed to a very small volume. These air inclusions are always under a pressure practically equal to the pressure under which the liquid metal is forced into the mold, a stress approaching the creep limit of the metal. Normally, these inclusions are of little consequence because they are generally quite small, but, when the die casting process is followed by a heat treatment, blisters arise which often render the material useless. The blisters result from the reduced creep limit at elevated temperatures and the increased pressure exerted by the trapped air.

With the new machine, a vacuum pump is attached to channels which connect with the mold space. When

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ALSO AVAILABLE IN ADDITIONAL TYPES

★ NON-CONTAMINATING

★ RESISTANT TO RUST AND CORROSION

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★ RESISTANT TO HEAT

★ EASY TO FABRICATE

★ STRONG...LONG LASTING

Your nearby Steel and Tubes Representative will be glad to answer your questions about the proper application of ELECTRUNITE Stainless Steel Tubing and Pipe. Just let us know when you would like him to call.

Pressure tubing for heat exchangers and condensers . . . piping for food, chemical and petroleum processing equipment . . . ornamental tubing for railings, grilles and decorative use . . . these are but some of the countless applications for long-lasting ELECTRUNITE Stainless Steel Tubing and Pipe.

As manufactured by the ELECTRUNITE Process, these modern tubular products are uniformly straight, strong and sound throughout every length and every shipment. And as indicated above, they are available in a wide range of analyses, gauges, sizes and shapes.

For complete information about ELECTRUNITE Stainless Steel Tubing and pipe, write today for a copy of Republic's new 28-page helpful fabricating guide.

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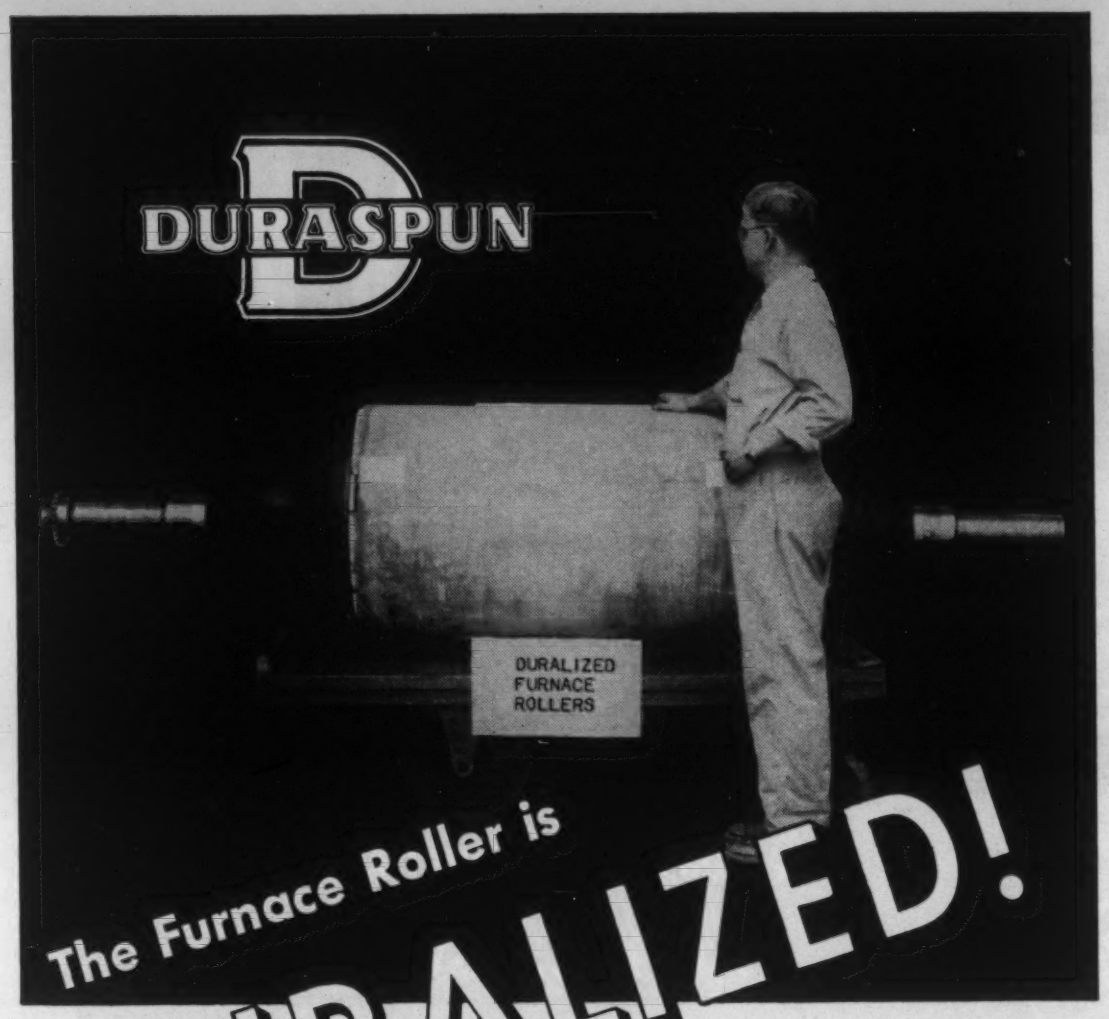
STAINLESS STEEL TUBING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ROLLERS
The Furnace Roller is
DURALIZED!
And what is "Duralizing"?
It's a surface treatment given to the casting
1 . . . to make it more resistant to abrasion
2 . . . to make it more resistant to molten metal
3 . . . to minimize "pick up"

This is a treatment we developed in our own laboratory and foundry to meet special conditions for certain furnace operations. Normal high alloy castings would withstand the heat all right but abrasion, erosion and pick up were something else again. The "Duralized" Rolls solved the problem.

While you may not need a high alloy casting calling for the Duralizing treatment, you may have a high alloy casting problem. We'll be glad to study it with you and recommend the alloy and type of casting best for your requirements.

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News Digest (continued)

the vacuum is applied, liquid metal rises through a feed pipe at an ever increasing rate. Because of the great velocity of the metal, the evacuated mold is filled and the metal flows over into the channels; the height of these channels is such that the metal solidifies in them before it can run out again. As a result, the stream of liquid metal is halted and its kinetic energy is suddenly converted into pressure. It is due to this pressure, which rises for an instant to about 100 atm., that the remaining spaces in the mold are completely filled. As soon as the metal in the mold has solidified, the mold-holder is disconnected from the feed pipe and the molten metal in the pipe descends.

Principal disadvantage is that interchangeable molds are required, and this is only practicable for small parts. Using two mold-holders and molds alternately, however, a production of about 250 shots per hr. has been achieved with this machine.

Lead alloys and zinc alloys containing aluminum and copper have been successfully cast with this machine. Attempts to work aluminum alloys have been largely unsuccessful because of corrosion of the feed pipe in the crucible.

Data on Temperature Properties Given for Laminated Plastics

Extensive data on the mechanical properties of laminated plastics at different temperatures are presented in a paper by John L. Lamb, Isabelle Albrecht and Benjamin M. Axilrod, published in the *Journal of Research of the National Bureau of Standards* (September).

Laminates of an unsaturated polyester reinforced with glass fabric and of phenolic resin reinforced with asbestos fabric, high-strength paper, cotton fabric and rayon fabric were tested in impact, bending, tension and compression at —70, 77 and 200 F.

Test results indicate that the impact strength of the glass-fabric laminate is highest at —70 F and lowest at 200 F; the impact strengths of cotton- and rayon-fabric laminates are lowest at —70 F and highest at 200 F; and the paper and asbestos-fabric laminates have small changes in impact strength with temperature. For all materials tested, the flexural, tensile and compressive strengths and the moduli of elasticity increase at

—70 F and decrease at 200 F, relative to the 77 F values.

The test results further indicated that the flexural properties of plastic laminates at high temperature are not a function of temperature alone, but may be affected by further cure of the resin and loss of moisture content. Tests run at room temperature after heating the materials 24 hr. at 200 F indicate that prolonged heating with consequent loss of moisture and further cure of the resin may offset the effect of high temperature alone. The effect of high humidity in addition to an elevated temperature, on the other hand, may be much different from the effect of the high temperature alone. A severe loss in flexural strength was noted for two laminates at 150 F and 90% relative humidity.

Studies Show Gas Turbine Rotors Can Be Cast at Reasonable Cost

Preliminary studies seem to indicate that cast gas turbine rotors can be satisfactorily produced at reasonable cost, and with an important saving of the forging capacity now employed for this purpose, according to a report issued by the Office of Technical Services of the U. S. Department of Commerce. The report summarizes three years of investigation at the Massachusetts Institute of Technology for the Navy's Bureau of Ships.

The investigation showed that, in addition to the relative simplicity of the casting process, the high-temperature strength of an alloy is generally greater in cast than in forged state. Thus, the casting process can be used to provide additional strength or to make possible the use of lower alloys.

Investment casting, one of the processes utilized in this investigation, is particularly suitable for high temperature alloys for many uses. In general, these castings were rather coarse-grained. Casting into graphite molds produced fine-grained columnar castings which generally had much poorer surfaces than were obtained by precision casting.

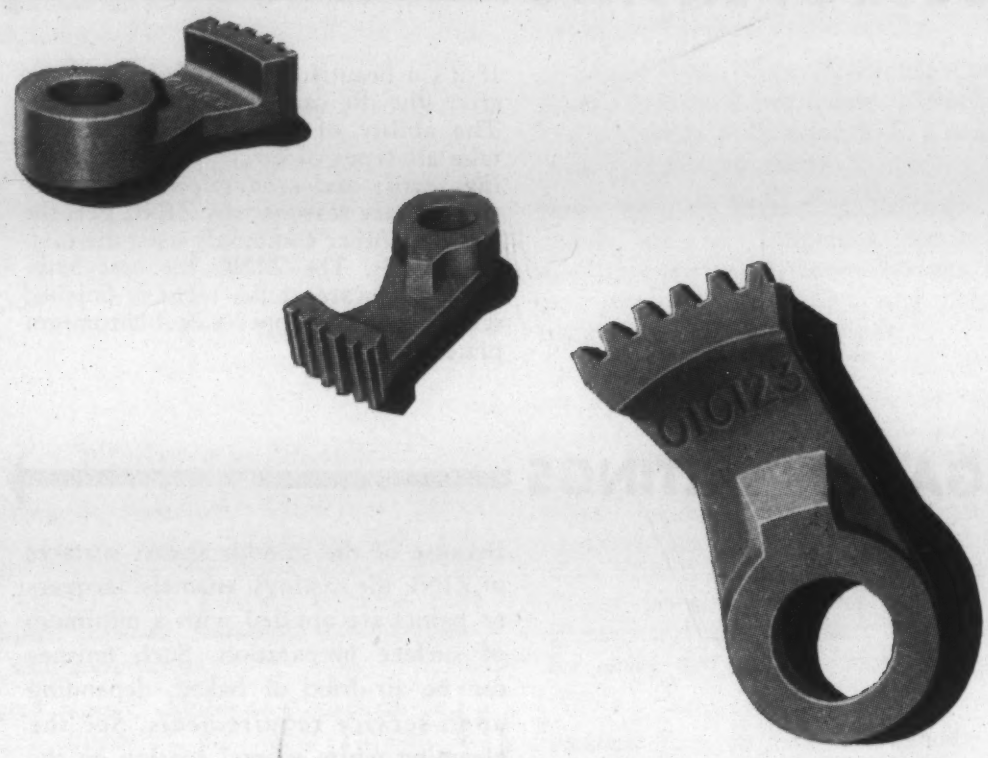
The complete 54-page report, No. PB 98962, is available from the Library of Congress, Washington 25, D. C., at $2.50 in microfilm and $7.50 in photostat form.

(More News on page 128)

MICROCASTING

ELIMINATES SPECIAL TOOLING

ESTIMATED SAVING 75%



Microcast parts are smooth, uniform, sound as cast (actual size).

Quantity Production of Intricate Parts from High-Melting-Point Alloys

BY using the MICROCAST PROCESS to produce this alloy steel rocker arm for packaging machinery, the manufacturer saved an estimated 75% over conventional production methods. Microcast can effect remarkable savings by eliminating the necessity of forging dies, special tooling, drilling, and similar operations.

Metallurgists and design engineers will find that with Microcast there are many opportunities for product improvement. Because Microcastings, as cast, are of sound structure, dimensionally uniform, and to such close tolerances that virtually no machining is required, small components of intricate shape can now be specified in the extremely hard, non-machineable, and non-forgeable alloys such as stainless steel, tool steels, Stellite, and others. Write today for complete information.

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FREE BOOKLET
Send for 16-page Microcast Booklet. Contains many "case histories" and step-by-step explanation of Microcast Process.

MICROCAST PRECISION CASTINGS PROCESS

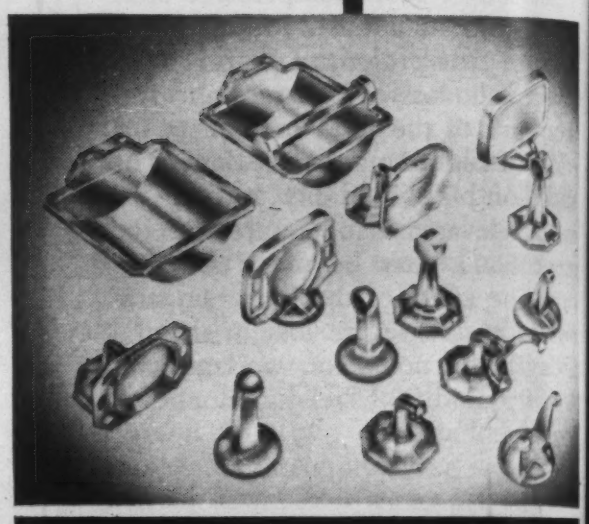
MICROCAST

FINISHABILITY!

Yes, ZINC DIE CASTINGS CAN TAKE ALL OF THESE FINISHES

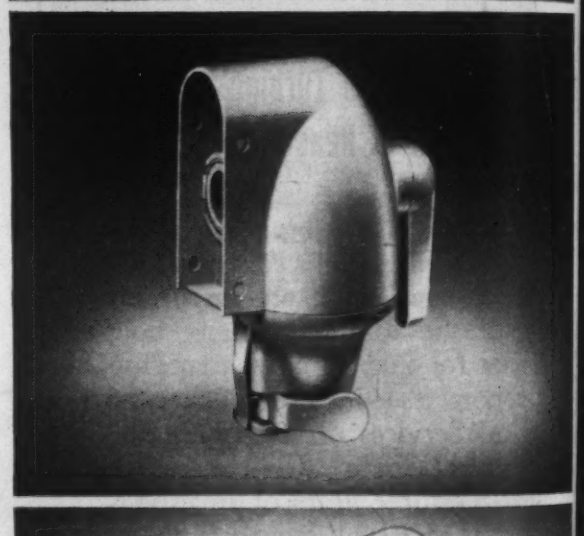
ELECTROPLATING

If it's a beautiful plated finish you are after, the die casting should be ZINC. The ability of ZINC die castings to take all types of electrodeposited coatings *easily* and *economically* is one of the primary reasons why ZINC gets the call over other commonly used die casting metals. The ZINC die cast bathroom hardware at the right is finished with a durable copper-nickel-chromium plate.



ORGANIC COATINGS

Because of the smooth as-cast surfaces of ZINC die castings, enamels, lacquers or paints are applied with a minimum of surface preparation. Such finishes can be air-dried or baked, depending upon service requirements. See the gleaming white enamel coating on the ZINC die cast washing machine wringer-head pictured at the right.



SPECIAL FINISHES

Special finishes for particular protective or beautifying effects are frequently applied on ZINC die castings. These take the form of chemical treatments, plastic coatings or decalcomanias. The automobile carburetor at the right has been Cronak treated—a corrosion-inhibiting chromate coating process developed and patented by The New Jersey Zinc Company.

A combination of many advantages—of which finishability is only one—make ZINC die castings the most widely used. Every die casting company is equipped to make ZINC die castings and will be glad to discuss these advantages with you. Or write to us.

The New Jersey Zinc Company, 160 Front Street, New York 7, N. Y.

ZINC
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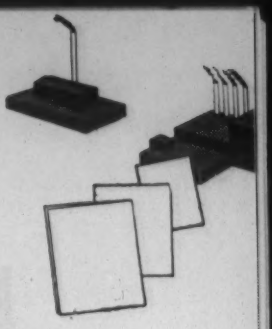
HORSE HEAD SPECIAL (99.99 + % Uniform Quality) ZINC



MANUFACTURERS' LITERATURE

Materials

Iron and Steel

Hobbing Steel. Carpenter Steel Co. Folder on new case-hardening, alloy mold steel for hobbed and machined molds which offers good machinability and high strength for long runs. (1)

Stainless Casting Alloy. Cooper Alloy Foundry Co., 4 pages, illustrated, reprint from MATERIALS & METHODS. Properties and uses of the molybdenum-bearing, chromium-nickel steel casting alloy, CF-8M. (2)

Low-Alloy Steels. Great Lakes Steel Corp., 8 pages, illustrated, No. 1a/13. Composition, properties, heat treating and welding characteristics, and specifications of N-A-X High Tensile Steel. (3)

Perforated Metals. The Harrington & King Perforating Co., 4 pages, illustrated, No. 1a/33. Shows wide variety of standard patterns of perforated ferrous and nonferrous sheet metal available. Specifications listed. (4)

Low Alloy Steel. Inland Steel Co., 4 pages, illustrated, No. 1a. Properties, advantages and applications of Hi-Steel, high-strength low-alloy steel. Also describes Copper-Alloy, Ti-Namel and 4-Way Floor Plate. (5)

Induction Hardened Bar Steel. Jones & Laughlin Steel Corp., 8 pages, illustrated, No. AD-99. Principal advantages of Electreat cold finished steel bars, heat treated by induction coils. Charts show hardenability and mechanical properties. (6)

Cold-Finished Steels. Kidd Drawn Steel Co., 4 pages, illustrated, No. 1a/17. Describes available flats and squares, needle bar stock, alloy steels, carbon tool steels, file steels and special shapes. (7)

Clad Steels. Lukens Steel Co., 68 pages, illustrated. Compositions, mechanical properties, corrosion ratings and applications of nickel-clad, stainless-clad, Inconel-clad and Monel-clad steels. (8)

Machining Malleable Iron. Malleable Founders' Society, 8 pages, illustrated, reprint. Reviewed previously. Practical information on machining rates, based upon a number of typical castings. (9)

Textured Metals. Rigidized Metals Corp., 4 pages, illustrated, No. 1a/25. Characteristics of rigidized ferrous and nonferrous metals, available in strip and sheet, solid or perforated. How texturing reduces weight and cost by increasing rigidity and strength. (10)

Screw Steel. Joseph T. Ryerson & Son, Inc., 2 pages. Describes Ledloy, a lead-bearing, open-hearth steel that machines from 30 to 50% faster than the fastest-cutting screw steel previously available, and has good ductility, strength and case-hardening qualities. (11)

Nonferrous Metals

Forming of Aluminum. Aluminum Co. of America, 66 pages, illustrated, No. AD-130. Comprehensive descriptions and data on blanking and piercing, drawing, drop hammer forming, stamping, spinning, etc., of aluminum alloys. (12)

Plated Metals. American Nickeloid Co., 8 pages, illustrated, No. 1a/4. Physical and fabricating properties, advantages and typical uses of Nickeloid Metals, consisting of steel or nonferrous metals with durable electroplated coatings. (13)

Resistant Casting Alloy. Burgess-Parr Co., 4 pages, illustrated, No. 105. Physical properties and applications of Illium "G," a nickel-base, corrosion resistant casting alloy. Properties of wrought alloy, Illium "R," also listed. (14)

Thermostatic Bimetal. W. M. Chace Co., 4 pages, illustrated, No. 1a/10. Properties of Chace thermostatic bimetals, and detailed formulae and calculations used in their application to temperature responsive devices. (15)

Magnesium. Dow Chemical Co. (Magnesium Div.), 12 pages, illustrated, No. DM 76D-M-549. Physical properties of seven Dowmetal alloys; typical applications of sand and permanent mold castings, die castings, plate, sheet and strip, and extrusions; and information on machining, joining, forming and finishing of magnesium. (16)

Spring Alloy. Elgin National Watch Co. (Industrial Products Div.), 2 pages. Composition and properties of a new cobalt-chromium-base spring alloy, Elgiloy, having high corrosion resistance, set and fatigue resistance, hardness and elasticity. (17)

Aluminum Alloy. Frontier Bronze Corp., 4 pages. Reviewed previously. Composition and properties of Frontier 40-E, a non-heat-treated aluminum alloy. (18)

Brass. Mueller Brass Co., 16 pages, illustrated, No. 1a. Properties, specifications and applications of brass forgings, screw machine parts, fabricated tubing, rod, bearing metal, castings and fittings. (19)

Nonmetallic Materials

Glass. Corning Glass Works, 12 pages, illustrated, No. IZ-I(1e). Lists eight advantages offered by Corning Glass in product design; physical properties of 15 different glasses; and design limits and tolerances for sheet, and pressed, blown and drawn ware. (20)

Plastics. E. I. du Pont de Nemours & Co. (Inc.), 10 pages, illustrated, No. 1 B/3. General descriptions and specific advantages and uses of Lucite, Polythene, Nylon, Butacite, Pyralin, Plastacele and Teflon. (21)

Resins and Molding Compounds. Durez Plastics & Chemicals, Inc., 8 pages, illustrated. Lists physical properties and applications of 23 Durez phenolic molding compounds and describes 15 different fields of application for phenolic resins. (22)

Fabricated Plastic Equipment. Maurice A. Knight, 4 pages, illustrated. Physical and chemical characteristics of Permanite, a group of resins used to mold large pieces of chemical processing equipment for corrosion resistant services. Typical applications shown. (23)

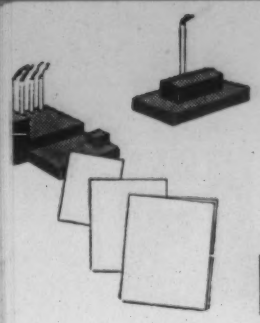
Glass. Kopp Glass, Inc., 4 pages, illustrated, No. 1e/2. Describes this company's service in supplying custom-made glass products for industrial use. (24)

Glass. Libbey-Owens-Ford Glass Co., 8 pages, illustrated, No. SPD-50. Specifications and applications of various types of glass suitable for engineering and product design. (25)

Glass. Pittsburgh Plate Glass Co., 4 pages, No. 1e/4. Lists size and weight specifications, strengths, colors and finishes of 19 different glass products, including Carrara structural glass, X-ray lead glass and PC glass blocks. (26)

Carbon Parts. Superior Carbon Products, Inc., 4 pages, illustrated, No. M-1. Advan-

To obtain literature appearing on these pages, please refer to easy-to-use reply card on page 125.



MANUFACTURERS' LITERATURE

tages of using Super-Graph carbon parts, especially designed to fit specific applications, such as bearings, valves and seal ring assemblies. (27)

Parts and Forms

Plastic Moldings. Accurate Molding Co. Describes facilities for producing precision plastic moldings. Case histories given. (28)

Flexible Plastic Tubing. Alan Plastics Corp. Folder on properties and uses of Alanol Flexible Tubing made of non-contaminating plastic. (29)

Non-Slip Steel Plate. Alan Wood Steel Co., 8 pages, illustrated. Specifications and workability characteristics of A. W. Algrip abrasive-rolled, steel floor plate, designed for non-skid applications in industrial installations. (30)

Stainless Steel Parts. Amplex Manufacturing Co. (Div. of Chrysler Corp.), 1 page, illustrated. Describes bearings, finished machine parts and permanent filters made from Oilite stainless steel. (31)

Nonferrous Plaster Mold Castings. Atlantic Casting & Engineering Corp., No. 4. Reviewed previously. Describes production of "Atlanticastings" of copper-base and aluminum alloys, poured in plaster molds to tolerances of ±0.005 in. (32)

Steel Tubing. Bundy Tubing Co., 20 pages, illustrated. Mechanical and corrosion properties, fabricating and finishing characteristics, specifications and typical fabricated parts of Bundyweld double-walled, copper-coated steel tubing. (33)

Rubber Parts. Continental Rubber Works, 4 pages, illustrated, No. 1c/1. Description of molded, extruded, and die and lathe cut parts of rubber manufactured by this company. Specification check list included. (34)

Moldings and Shapes. Dahlstrom Metallic Door Co., 4 pages, illustrated, No. 1a/32. Pictures variety of pressed or rolled shapes which can be furnished in any common metal, plus welded steel tubing. Specifications included. (35)

Metal Stampings. Dayton Rogers Manufacturing Corp., 8 pages, illustrated. Describes service which provides duplicate die-cut stampings in small lots for industry. Lists size limitations, materials available and several case histories. (36)

Die Castings. Doehler-Jarvis Corp., 4 pages, illustrated. Advantages of the die-cast aluminum automobile door panel developed by this company. Discusses possible future applications of large die castings. (37)

Forgings. Drop Forging Assn., 60 pages, illustrated. Describes metal quality as developed in forgings formed in closed impression dies. Production techniques and economic advantages of forging given. (38)

Gray Iron Castings. Eaton Manufacturing Co., 18 pages, illustrated. Describes this company's facilities for producing permanent-mold gray iron castings. Lists physical properties and shows typical parts manufactured. (39)

Nonferrous Castings. Eclipse-Pioneer Div. Foundries. Describes modern techniques and equipment used in producing sand, permanent mold and die castings, and precision plaster mold castings of magnesium, aluminum and bronze. (40)

Molded Products. Garlock Packing Co., 4 pages, illustrated, No. 4j. Shows range of Garlock products, including mechanical packings, gaskets, oil seals and mechanical molded products, and their applications in resisting heat, pressure and chemicals. (41)

Steel Tubes. Globe Steel Tubes Co., 8 pages, illustrated, No. 1a/12. Specifications and tolerances for this company's seamless and Gloweld-welded tube and pipe of carbon, alloy and stainless steel, and of Globe-iron. (42)

Precision Castings. Gray-Syracuse, Inc., 4 pages, illustrated. Reviewed previously. Shows various small parts precision-cast of brass, bronze, beryllium, copper, and carbon, stainless, tool and high-temperature steels. (43)

Helical Compression Springs. Instrument Specialties Co., Inc., 2 pages, illustrated. How to obtain an "engineer's assortment" of 100 beryllium copper helical compression springs that will save time and money in development work. (44)

Centrifugal Castings. Janney Cylinder Co., 4 pages, illustrated. Composition and properties of this company's stainless steel centrifugal castings. Shows typical parts finish-machined from castings. (45)

Gray Iron Castings. Meehanite Metal Corp., 8 pages, illustrated, No. 30. Reviewed previously. One of a series of bulletins describing current uses of Meehanite castings. (46)

Gaskets. Metallo Gasket Co., 4 pages, illustrated, No. 4j. Shows ten different types of gaskets which are metallic, metal-containing or metal-enclosed. Available metals and pressure and temperature limits for gaskets listed. (47)

Investment Castings. Microcast Div. (of Austenal Laboratories, Inc.), 2 pages, illustrated. Shows typical parts made of high-temperature, difficult-to-machine alloys by precision investment casting. (48)

Bearings and Bushings. Morganite, Inc., 8 pages, illustrated, No. 1f. Specifications of various types of carbon bearings and bushings. Also lists properties and general characteristics of the six different series of Morganite carbon products. (49)

Woven Wire Parts. Newark Wire Cloth Co., 4 pages, illustrated. Describes a diversified line of metallic wire cloth, screen and woven wire products, produced in any commercial size, in all weaves and from all malleable metals. (50)

Welded Steel Tubing. Ohio Seamless Tube Co., 40 pages, illustrated, No. E-4. Comprehensive handbook on manufacturing methods, specifications, tolerances, properties and ordering of electric resistance-welded steel tubing. (51)

Die Castings. Parker White Metal Co., 8 pages, illustrated. Reviewed previously. Properties, advantages and case histories of aluminum, zinc and brass Parker die castings. Company's 16-point plan of production control explained. (52)

Spun Shapes. Phoenix Products Co. (Metal Spinning Div.), 4 pages, illustrated. Describes Phoenixspun method for producing spherical and extra deep-drawn contours in various diameters, and in hard metals up to 3/8-in. thickness. (53)

Forgings. Pittsburgh Forgings Co. (and Greenville Steel Car Co., subsidiary), 64 pages, illustrated. Shows manufacturing facilities and typical products, including freight cars, farm implements and a variety of steel forgings. (54)

Small Tubing. Precision Tube Co., Inc., 4 pages, illustrated, No. 100-G2A. Discusses shapes, sizes, materials, tempers, tolerances and finishes in which this company's small seamless tubing can be produced. (55)

Welded Tubing. Republic Steel Corp. (Steel & Tubes Div.), 8 pages, illustrated, No. 1a/19. Advantages offered product designer by Electrunite electric-welded mechanical and pressure tubing. Properties listed and 12 case histories described. (56)

Steel Castings. Unitcast Corp., illustrated, No. 249-S. Folder showing some of this company's facilities and explaining control procedures used in producing Unitcastings, high-quality electric steel castings. (57)

Coatings and Finishes

Phosphate Coating. American Chemical Paint Co., 4 pages, illustrated, No. 410A. Describes applications of Duridizing, a cleaning and phosphate coating process for steel and cleaning process for nonferrous metals. (58)

Rust Remover. Diversey Corp., 1 page, illustrated. Reviewed previously. Five advantages of using Everite to remove rust, heat scale, hard water scale and discoloration from metal surfaces. (59)

White Enamel. Hilo Varnish Corp., No. 26. Sheet on characteristics and use of Nu-Syntol, a new, low heat-short bake, 100% synthetic white enamel which has moderate toughness and good durability. (60)

White Enamel. Maas & Waldstein Co. Describes Codur, a gloss white baking enamel. (61)

Metallizing. Metallizing Engineering Co., Inc., 8 pages, illustrated, No. 62. Reviewed previously. Describes a variety of iron and

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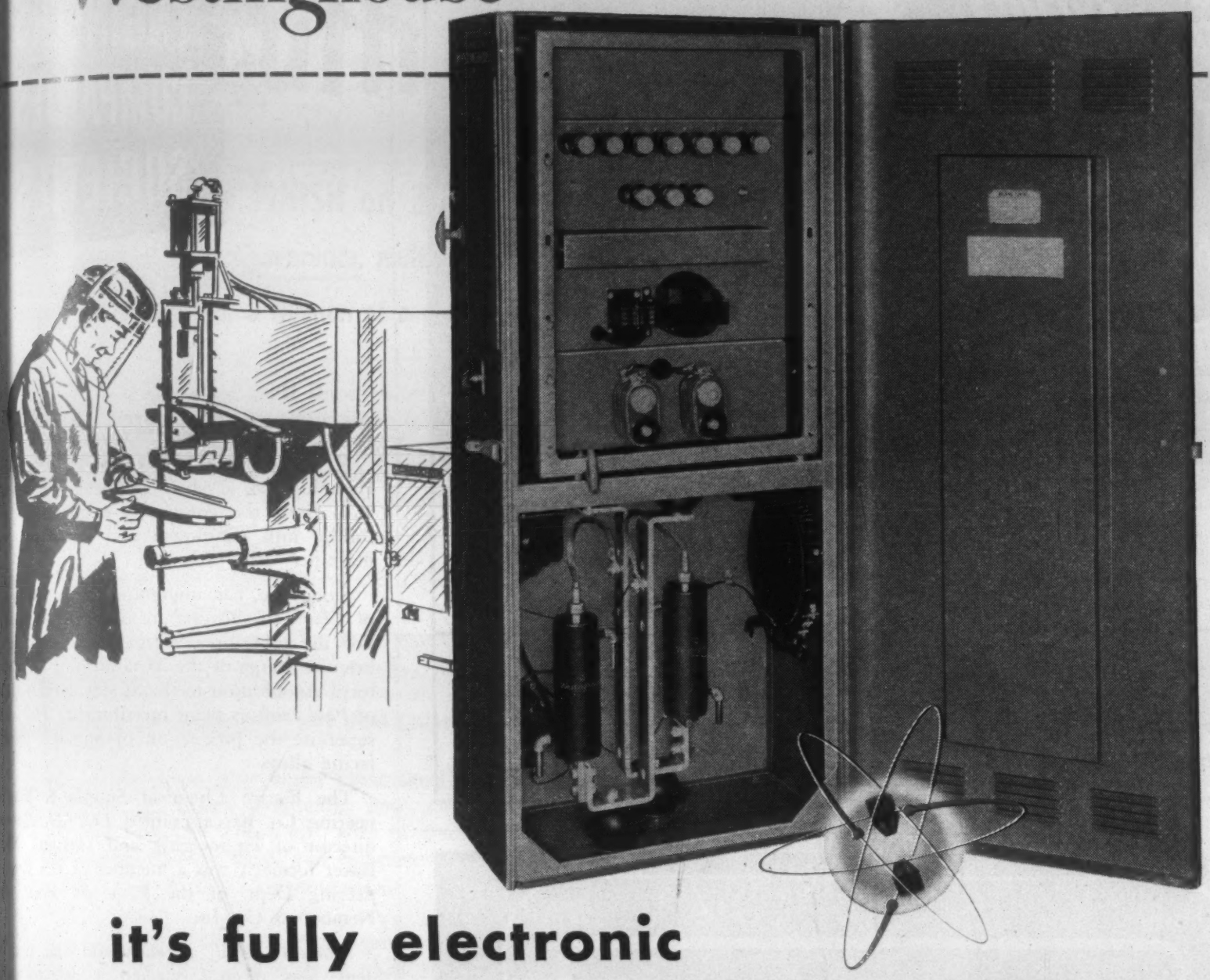

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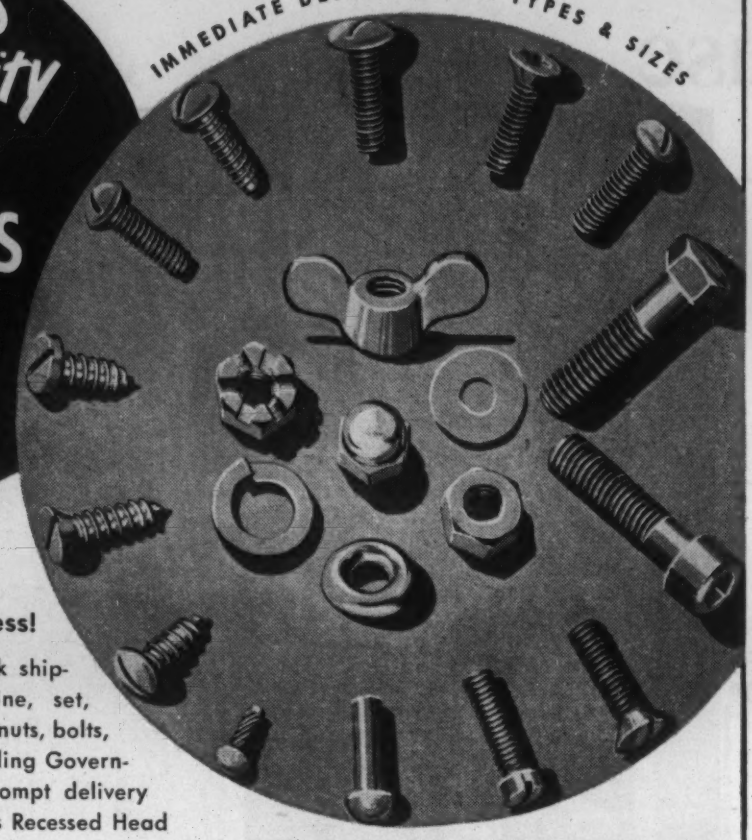

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News of...

ENGINEERS COMPANIES SOCIETIES

Engineers

R. J. Leckrone has joined Mackintos Hemphill Co. as chief engineer, where h will direct the company's engineering rolling mill equipment and assist in th machinery sales program.

Stoody Co. has announced the promotio of *Charles E. Rogers* to sales metallurgi For the past three years Mr. Rogers ha been in charge of the Metallurgical Labora tory. An addition to the Stoody staff is th of *Paul Irish* as plant metallurgist. He wi supervise the production of Stoody's hard facing alloys.

The Electro Chemical Supply & Engi neering Co. has appointed *Fred G. Bak* director of Engineering and Design. M Baker formerly was a member of the Engi neering Dept. of the E. I. du Pont d Nemours & Co., Inc.

Morse G. Dial, secretary and vice presi dent, was recently elected a director o Union Carbide & Carbon Corp. *Kenne H. Hannan,* assistant secretary and treasure succeeds Mr. Dial as secretary.

Tungsten Alloy Manufacturing Co., In has appointed *Harry C. Gross* chief chemi and metallurgist. Under this new arrang ment the company acquired the G. & Laboratories, specialists in metallurgi analysis of powdered metals, and former owned and operated by Mr. Gross. *Stan Tarkan* will assist Mr. Gross in the expande company operations.

Seven executives of the General Electr Co.'s Apparatus Dept. have been named t new positions. They include *Neil Curr Jr.,* from manager of manufacturing to a ministrative assistant to the general man ager; *Ernest E. Johnson,* from manager engineering to manager of engineering— Large Apparatus Divs.; *Carl A. Salmons* from manager of the Aircraft Gas Turbi Divs. to manager of manufacturing—Lar Apparatus Divs.; *Byron A. Case,* from a sistant to manager of engineering to man ger of engineering—Small Apparatus Divs *Frank T. Lewis,* from manager of manufa turing—Aeronautic & Ordnance Systems Divs. to manager of manufacturing—Sma Apparatus Divs.; *Clarence H. Linder,* fro assistant manager of manufacturing to a sistant to the general manager; and *C. W La Pierre,* from assistant manager—Aircra

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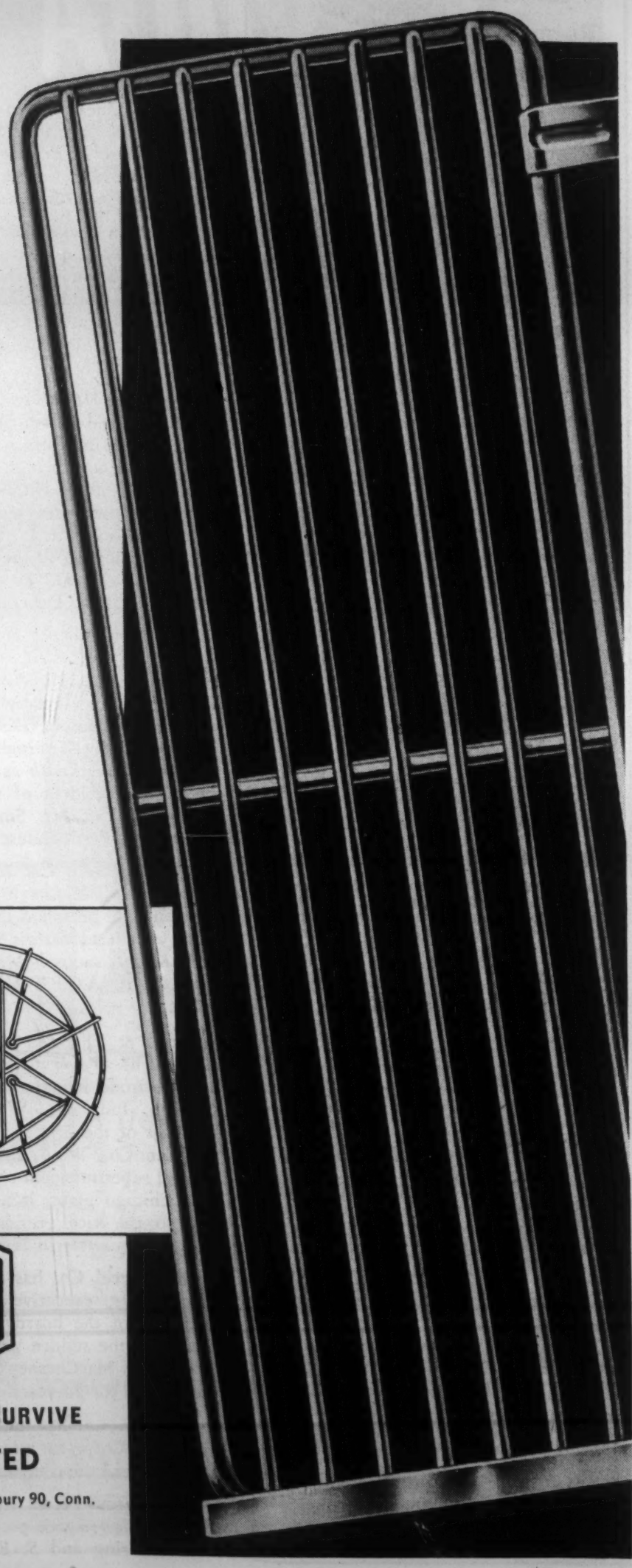
UNICHROME DIP FINISH on ZINC PLATE

adds chromium-like appearance, multiplies the protection — for only a fraction of a cent per sq. ft.!

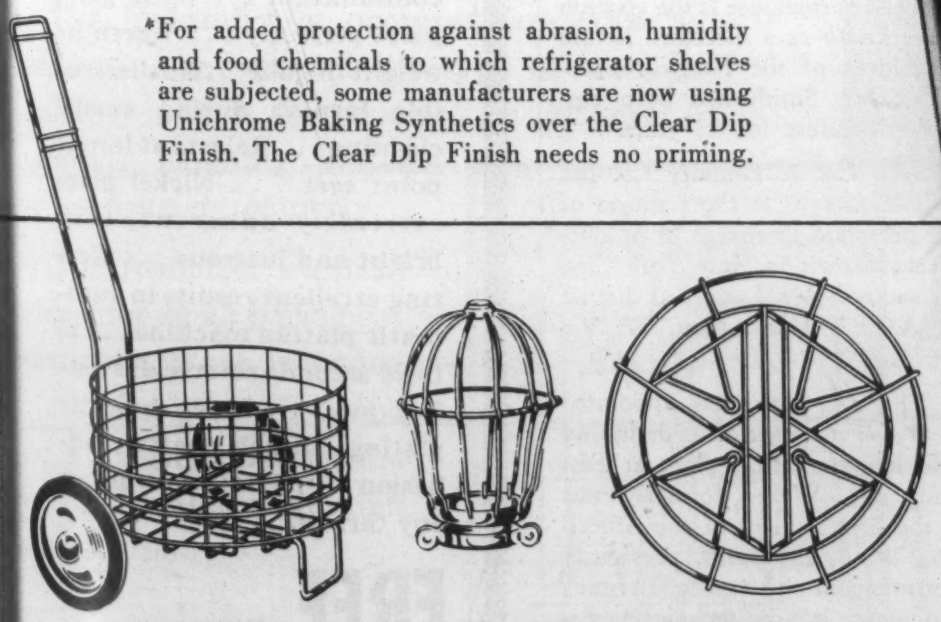


This refrigerator shelf shows what you can do for greater economy in your production. If any wire product needs an attractive finish as well as a serviceable one, it's a refrigerator shelf. Significantly, many of today's well-known manufacturers have shelves zinc plated and finished in Unichrome Clear Dip.* For not only is such a finish outstanding in rust-resistance and brilliance, but it also pares costs without impairing quality!

Unichrome Clear Dip is a chemical treatment which produces an inactive coating which is integral with the zinc. The bluish-bright cast imparted is the image of chromium — and what's more, it *stays* that way!

With costs now under close scrutiny, take a tip from the many companies now using Unichrome Clear Dip to "dress up" wire products — check the quality of this finish and compare the costs. It will pay you. Write us for more data.

*For added protection against abrasion, humidity and food chemicals to which refrigerator shelves are subjected, some manufacturers are now using Unichrome Baking Synthetics over the Clear Dip Finish. The Clear Dip Finish needs no priming.



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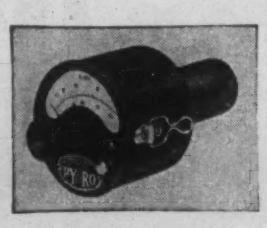

Tells spot temperatures instantly in heat-treating furnaces, kilns forgings and fire boxes. No thermocouples, lead wires or accessories needed! Temperature indicated on direct-reading dial at a press of the button. Any operator can use it. Two double-ranges for all plant needs. **Write for FREE Catalog No. 100.**

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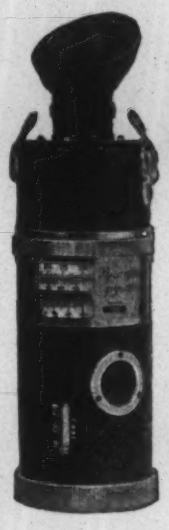
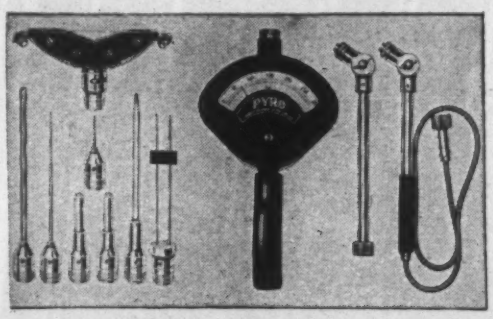


Determines temperatures of minute spots, fast-moving objects and smallest streams — at a glance! No correction charts or accessories needed. Easy to use—weighs only 3 lbs. Special types available to show true spout and pouring temps. of molten ferrous metal measured in open. Five temp. ranges. **Write for FREE Catalog No. 80.**



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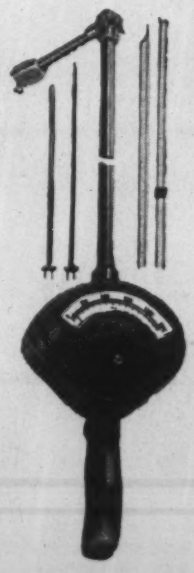

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News of...

ENGINEERS COMPANIES SOCIETIES

Gas Turbine Divs. to manager of the same division. One other appointment by G.E. concerns its Aeronautic & Ordnance Systems Divs., where *F. B. Law,* formerly assistant to the manager, succeeded Mr. Lewis as manager of manufacturing.

American Brake Shoe Co. has appointed *Harry C. Platt,* previously works manager, to the position of vice president of its Engineered Castings Div. and *William H. Starbuck,* formerly assistant general sales manager, to the office of vice president of its Kellogg Div.

Noble E. Hamilton is now associated with National Research Corp., where he will engage in research in the application of high vacuum to high temperature alloys. Until he joined National Research, Mr. Hamilton conducted metallurgical research at the Massachusetts Institute of Technology. Another addition to the staff is *Vincent C. Hall, Jr.,* who will be connected with the Applied Physics Dept. of National.

The Westinghouse Electric Corp. has appointed *J. O. Clevenger* as manager of its Welding Dept. He was formerly manager of agency and specialty sales for the company's Southeastern District. Another announcement by Westinghouse is the election of *Marvin W. Smith* as a director. Before becoming president of the Baldwin Locomotive Works, Mr. Smith had been employed by Westinghouse for 33 years.

The American Car & Foundry Co. has promoted *W. E. Lunger* to the position of assistant vice president in charge of production, with headquarters in New York City. *J. E. Koontz* succeeds Mr. Lunger as district manager of A.C.F.'s Huntington, W. Va. plant.

Metal & Thermit Corp. has appointed *Bernard W. Weber* manager of its detinning and electrode manufacturing plant at East Chicago, Ind. Mr. Weber formerly was manager of the Seattle plant of the American Can Co. *W. S. Leinhardt,* previously general superintendent of Metal & Thermit's East Chicago plant, is now technical assistant to the vice president of production, with headquarters in New York City.

Acme Steel Co. has elected *Chester M. MacChesney,* executive vice president, as chairman of the board, to fill the vacancy caused by the sudden passing of *Charles S. Traer.* Mr. MacChesney has been associated with Acme for 33 years.

John Kosmos has joined the staff of the Chemical Corp. as technical service man, and will head the company's new laboratory.

Non-Ferrous Perma Mold, Inc. has named *G. K. Eggleston* vice president in charge of manufacturing and *S. E. Gregory* general

"Oakite's new method for cleaning brass and copper before nickel and chrome plating is tops!"

From Connecticut to California, electroplaters are enthusiastic about the NEW Oakite brass-cleaning method that gives good protection against tarnish along with effective removal of oils and buffing compounds. Here are a few comments:

Wonderful cleaner for brass . . . Results have been excellent . . . Not a single reject on brass and copper work in two months . . . Good cleaning combination . . . All parts plate perfectly . . . Worth its weight in gold . . . No discernible tarnish during anodic cleaning . . . Rejects at lowest point ever . . . Nickel plate extremely adherent, very bright and lustrous . . . Getting excellent results in automatic plating machine . . . 15 to 20 seconds reverse did perfect job . . . Much brighter plating, much better adhesion . . . Could not detect any tarnish . . .

FREE Write today to Oakite Products, Inc. 34E Thames St., New York 6, N. Y., for full information.

OAKITE

OAKITE 1909 1949 40th ANNIVERSARY YEAR

SPECIALIZED INDUSTRIAL CLEANING MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada

ADVANCED COMBUSTION SYSTEM NEW MUFFLE DESIGN

Combined in the Revolutionary, New

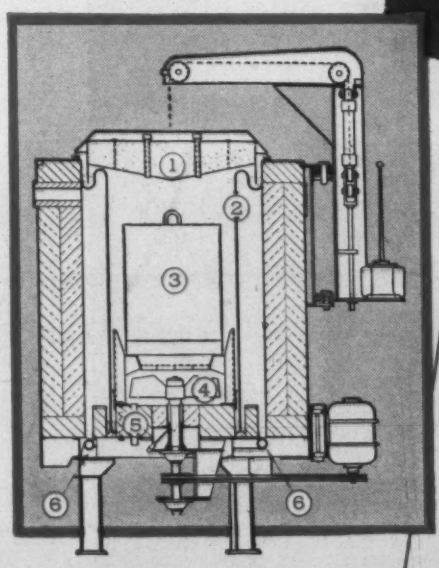
'Surface' Atmotrol VERTICAL MUFFLE FURNACE

• All modern heat treatments including clean hardening, without scale or decarburization, gas carburizing and dry (gas) cyaniding of steel parts are accomplished in the gas-tight, heat-resisting alloy muffle.

The 'Surface' Two Stage Multiple Injection Burner equipment does not require air under pressure and provides uniform temperature distribution throughout the muffle heating chamber. Maximum heating efficiency is assured.

The hydraulically operated top cover facilitates the vertical lift type of work handling which is popular in modern materials handling systems for industrial plants.

The Atmotrol Furnace is ideal for small parts heat treatment. Work is loaded in a basket through which the atmosphere gases are recirculated by a high capacity fan.

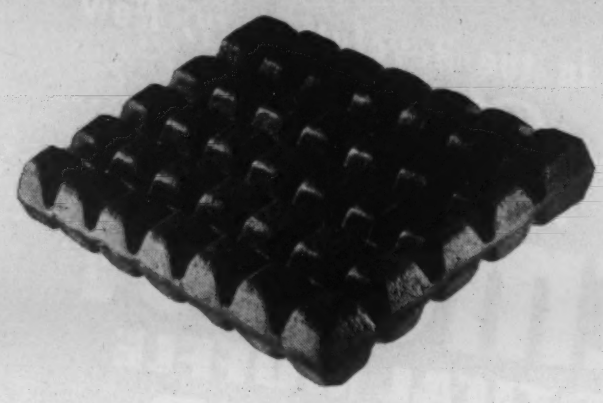


1 *Hydraulically Operated Lift Cover*
2 *Gas Tight Vertical Alloy Muffle*
3 *Materials Charge Basket*
4 *High Capacity Fan*
5 *Atmosphere Gas Inlet*
6 *Two-Stage, Multiple Injection Burners*

FREE!
COMPLETE FURNACE DATA
Write for Specification MV-49

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

'Surface' STANDARD RATED FURNACES AND INDUSTRIAL BURNERS

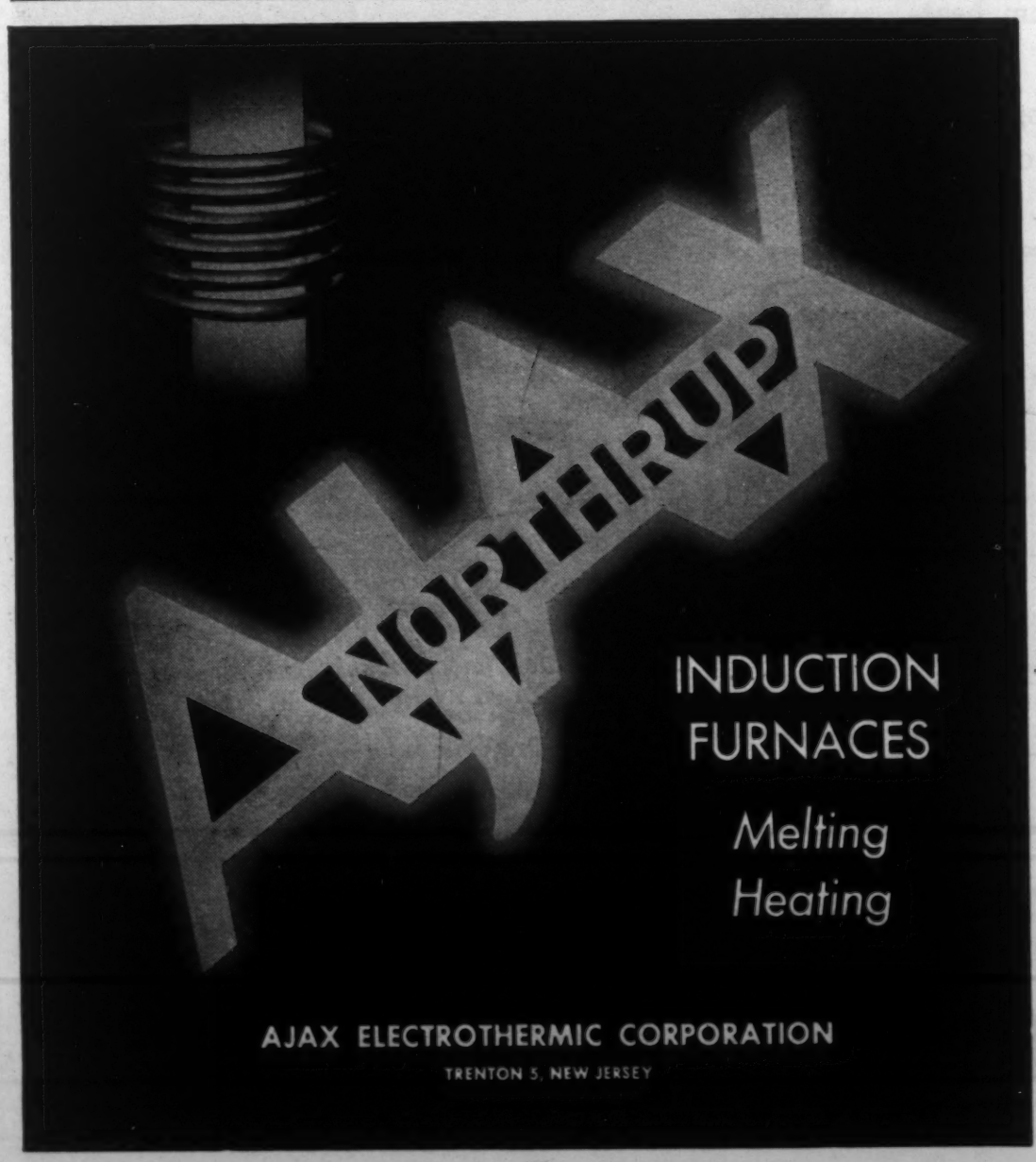


A Little Does a Lot

GCC CERIUM METAL (Mischmetal) added in small quantities to many Ferrous and Non-Ferrous Metals improves the metallurgical and mechanical properties of the end products.

Discover how a little does a lot by writing for our informative bulletins.

GCC **GENERAL CERIUM CO.**
EDGEWATER, NEW JERSEY



News of...

ENGINEERS COMPANIES SOCIETIES

sales manager of the corporation. Mr. Eg gleston formerly was vice president o engineering for the Barnes Manufacturi Co. Mr. Gregory comes directly from Lo don, England, where he was associated wi the Non-Ferrous Die Casting Co., Ltd. o London.

Detrex Corp. has just elected *Robert L Murray* a director of the corporation. H is executive vice president and director o Hooker Electrochemical Co., vice presid and director of Hooker-Detrex, Inc., and director of the Power City Trust Co.

Sherman M. Goble has joined Federa Metals Div. of American Smelting & Refi ing Co. as manager of its new Plating Electrochemical Dept. Mr. Goble, who h been connected with the Lea Manufacturi Co., will make his headquarters in Ne York City.

Brown-Hutchinson Iron Works has elec *Raymond J. Shillum* a member of t Board of Directors and promoted him the position of vice president in charge sales. Mr. Shillum had been sales manag of the company's Alloy Sales Div.

Glenn H. Edgecomb has joined the st of Jack & Heintz Precision Industries, In as works manager. He was formerly wor manager of Holtzer-Cabot Electric Co.

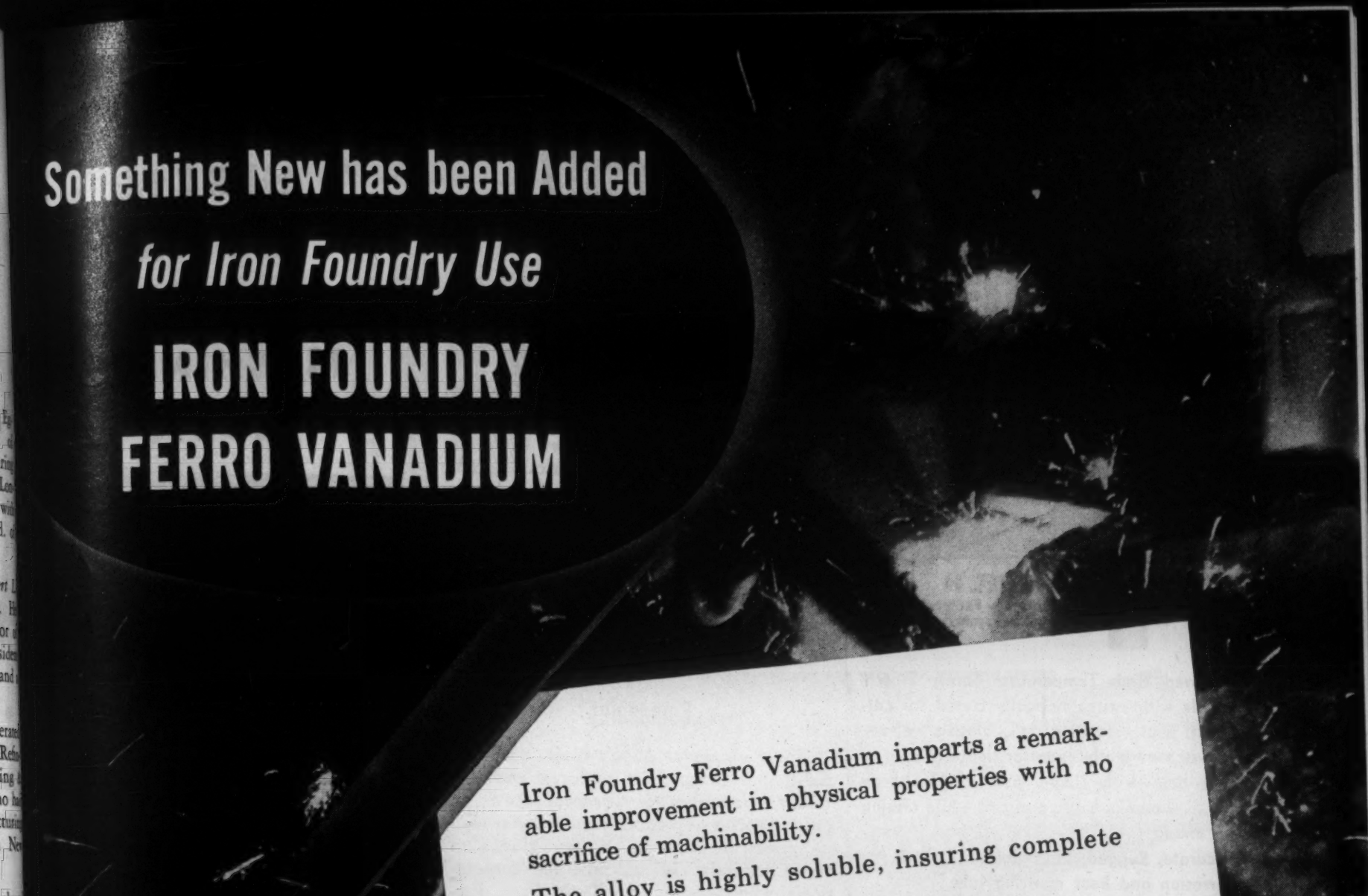
The Hanson-Van Winkle-Munning C has advanced two members of its Laborato staff. Dr. *D. Gardner Foulke* was nam chief chemist in charge of analysis a customer service. For the past three ye Dr. Foulke was process electrochemist, a he will continue to be responsible f H-VW-M's special processes. *Thomas Menzel,* analytical chemist, was promot to the position of plating chemist, and w be in charge of the company's new plati laboratory.

Robert W. Persons has been advanc to the position of product sales manager the Drill Steel Div. of Crucible Steel Co. America. Mr. Persons will make his he quarters in New York City.

The International Nickel Co. of Cana Ltd. has elected *R. Ewart Stavert* a direc of the company. Mr. Stavert is president the Consolidated Mining & Smelting Co. Canada, Ltd.

The appointment of *Stuart Smith* product manager of Aluminum Sheet Plate Sales was announced by Reyno Metals Co. Mr. Smith, who had be manager of aircraft sales for Reynolds, w make his headquarters in Louisville, Ky.

Ernest Richardson, retired president co-founder of the Ingram-Richardson M ufacturing Co., died recently. Mr. Richa son was also vice president of the Ingra



Something New has been Added
for Iron Foundry Use

IRON FOUNDRY FERRO VANADIUM

Iron Foundry Ferro Vanadium imparts a remarkable improvement in physical properties with no sacrifice of machinability.

The alloy is highly soluble, insuring complete diffusion.

It analyzes: Vanadium . . . 38 to 42%
Silicon . . . . . 7 to 11%
Carbon . . . . . about 1%

VANADIUM CORPORATION OF AMERICA

. . . INGTON AVENUE, NEW YORK 17, N. Y. • DETROIT • CHICAGO • CLEVELAND • PITTSBURGH

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VANCORAM
CHEMICALS AND METALS

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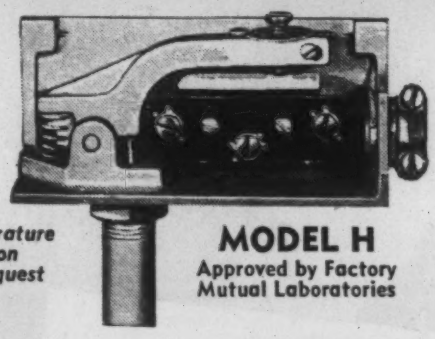
TEMPERATURE LIMIT SWITCHES

USE NO LIQUIDS . . . NO GASES



Literature on Request

MODEL H

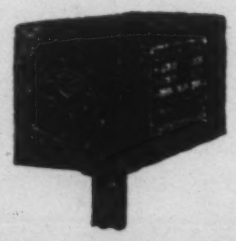
Approved by Factory Mutual Laboratories

Improved High Temperature Safety Switch. Available with switch normally closed for cutting off heat, stopping fan, closing valve—with switch normally open for lighting lamp or ringing bell—with single pole double throw switch . . . breaks heating circuit while closing alarm circuit.

- Accurate, Rugged, Dependable
- Corrosion and heat resisting tube
- Dial Pointer for easy setting inside case
- Locking screw locks temperature setting.
- Terminal plate has large screw terminals
- Snap-action Micro-Switch eliminates contact troubles
- Range minus 100° to 1400° F. Adjustable range 200 degrees
- Dimensions—5⅛" x 1¾" x 3"

MODEL V-I

For lower temperature range from 0-300°F. Available for minimum of —100° to maximum of 600°F. Usual adjustable range 50-150°, operating differential may be as small as ±¼ or as large as ±5°. Adjustable by screw and dial inside case. (Sizes 2¾" diameter × 4¼" high.)



MODEL D

Adjustable range 200-500°F. Temperature range 0-1400°F. For use where temperature must be changed to suit operating conditions. Turn outside knob to change temperature setting. (Sizes 5½ x 2¾ x 2¾".)

Instruments also Built to Specifications

Making Precision Controls for Over 12 Years

BURLING INSTRUMENT CO.

Springfield Ave. at Livingston St.

Newark, N. J.

News of...

ENGINEERS COMPANIES SOCIETIES

Richardson Manufacturing Co. of Indiana, Inc.

The death of *Carter Stanard Cole* has been announced by the American Society for Testing Materials. Mr. Cole had been an assistant technical secretary for the Society.

Companies

The *Permanente Metals Corp.*, Oakland, Calif., has changed its corporate name to *Kaiser Aluminum & Chemical Corp.*, in order to achieve a closer identification with its principal products—Kaiser Aluminum and Chemicals. In addition, the corporation's wholly-owned sales subsidiary, *Permanente Products Co.*, has been re-named *Kaiser Aluminum & Chemical Sales, Inc.*

The formation of a new division, entitled Engineering Projects, has been announced by the *Electronic Engineering Corp.*, Lyndhurst, N. J. This addition is a consulting service unit, and will operate at no cost to prospective clients.

The *Electro Chemical Supply & Engineering Co.* has moved its offices from Paoli, Pa., to its new office and plant at 750 Broad St., Emmaus, Pa.

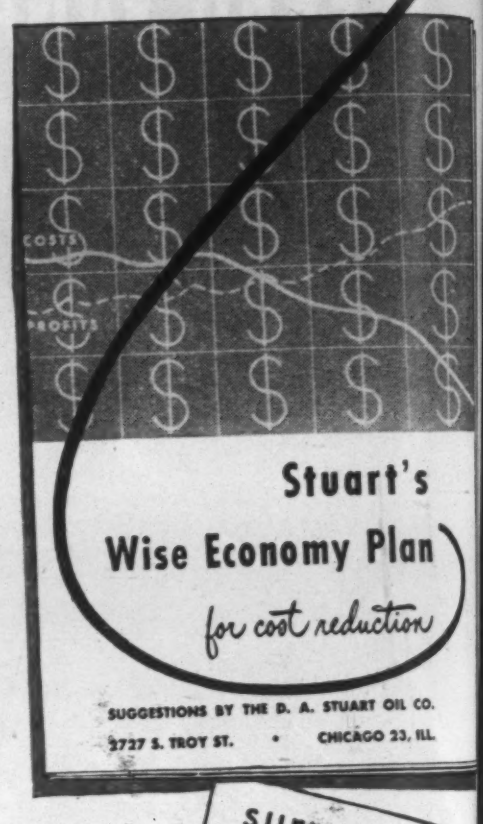
Organization of a new advanced engineering department has been announced by the *Panelyte Div.* of *St. Regis Paper Co.*, New York 17. This department will be responsible for forward planning and development of new laminated plastics materials and products manufactured by Panelyte. Robert W. Barber will head the new division, and George E. Vybiral succeeds Mr. Barber as chief engineer of the Panelyte Div.

A new laboratory, complete with modern equipment for research and testing in the metal finishing field, has recently been added by the *Chemical Corp.*, Springfield, Mass.

Construction of extensive new steel and pipemaking facilities in Lorain, Ohio, has been virtually completed by the *National Tube Co.* The new steel-making facilities alone will boost National Tube's rated output at Lorain to approximately 2,250,000 tons annually.

The *Industrial Chemicals Div.* of the *American Cyanamid Co.* has installed new production facilities for carburizing and heat treating compounds at its Kalamazoo, Mich., plant. The company will continue to manufacture some of these compounds at its Warners plant in Linden, N. J., but has added the new facilities in order to give

HERE IS THE WAY TO LOWER MACHINING COSTS



Stuart's Wise Economy Plan *for cost reduction*

SUGGESTIONS BY THE D. A. STUART OIL CO.
2727 S. TROY ST. • CHICAGO 23, ILL.

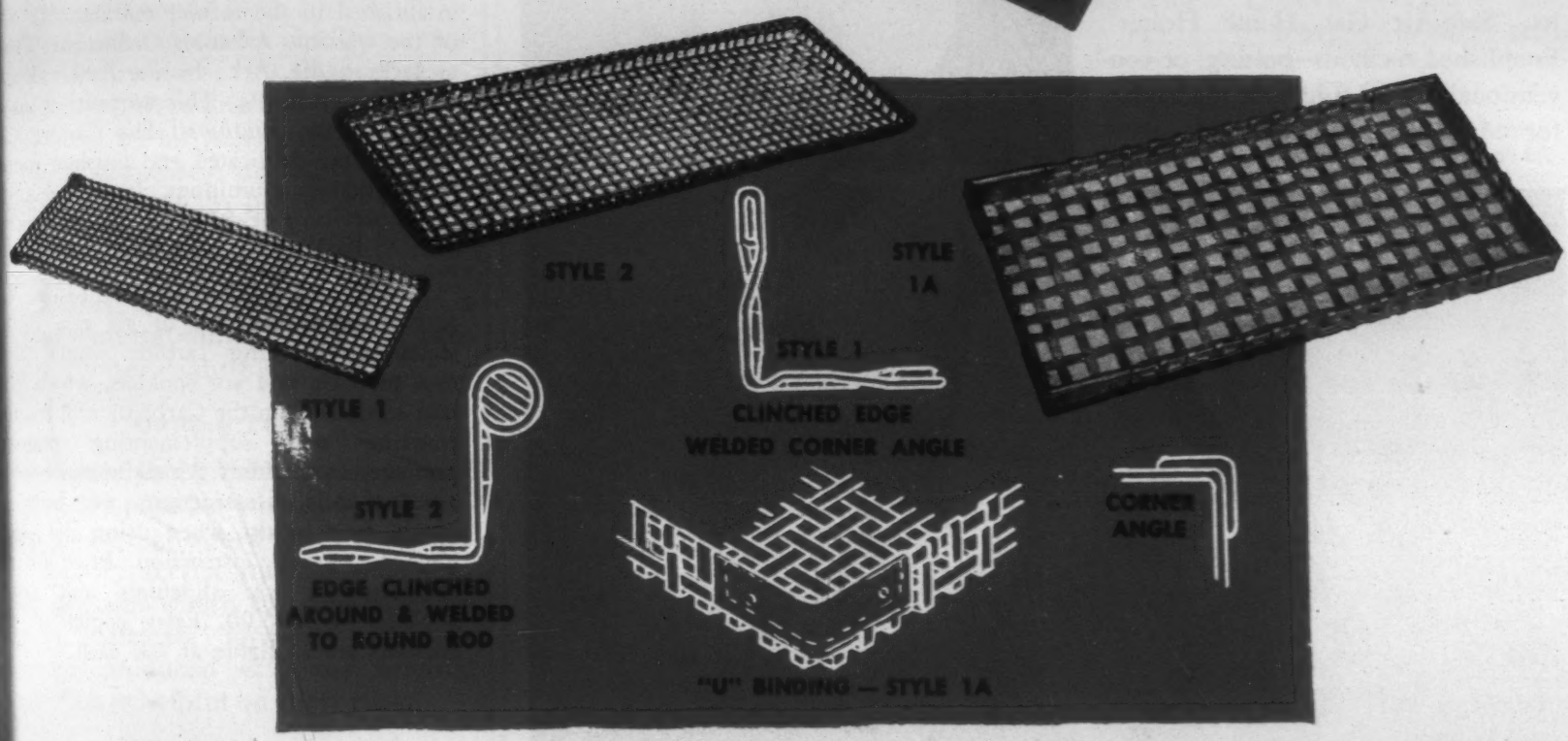
NOT just another spot check "oil survey", the Stuart plan is a scientific appraisal of a plant's over-all cutting fluid needs. Ask for details.

D.A. Stuart Oil CO.

2745 S. Troy St., Chicago 23, Ill.

ROLOCK

FABRICATED HEAT AND CORROSION RESISTANT ALLOYS



CUT COSTS WITH TESTED BRAZING TRAYS

If you have experienced bad scaling, broken wires, cracked corners, wire growth or too-early disintegration of brazing trays, we believe the following tests will be of great interest. A large manufacturer, in cooperation with Rolock engineers, made a detailed study of copper brazing tray design and materials. Six styles of baskets (4 different materials, 2 different mesh specifications) were exposed to electrically heated furnace temperature of 2050° F.

Result: Rolock ¼" x 1/16" flat wire Inconel trays, with riveted "U" binding corner construction, have been standardized by the manufacturer. They gave 3 *times the service life* of the *other specifications.*

We show above Rolock Brazing Trays... all with flat wire mesh. The "winner" is Style 1A. Style 1 is light in weight.. no top bar, but strengthened with corner angle. Style 2 has *top ring for extra strength.*

Rolock will design and build your Brazing Trays for your specific needs... give you longer service life, at lower costs... and a better job. Details and Catalog on request.

Offices in: PHILADELPHIA • CLEVELAND • DETROIT • HOUSTON • INDIANAPOLIS • CHICAGO • ST. LOUIS • LOS ANGELES • MINNEAPOLIS

ROLOCK INC. • 1282 KINGS HIGHWAY, FAIRFIELD, CONN.

JOB-ENGINEERED for better work
Easier Operation, Lower Cost

Aircomatic welding process Ups production of home heater units 71%... cuts manufacturing costs

THE STEWART-WARNER CORPORATION, South Wind Division, Indianapolis, Indiana, had a problem joining the upper and lower halves of its "Safe-Air Gas Home Heater". Established methods—bolting, or conventional arc welding were inadequate for today's production demands.

D. P. Carey, Airco Technical Sales Representative, was called in. He suggested the completely new, high speed, inert gas-shielded metal arc method of welding stainless steels, aluminum and other hard-to-weld metals . . . the Aircomatic Process. Two heaters were shipped to the Airco laboratory for test welding. The test was 100% successful, and the company immediately ordered Aircomatic equipment and put it to work on a production-line basis.

As a result, former production of 7 units per hour has been increased to 12 units per hour . . . with an accompanying reduction in production costs.

If you want more information about Airco's Aircomatic Welding Process, write your nearest Airco office for copies of forms ADR-53 and ADC-661.

TECHNICAL SALES SERVICE—ANOTHER AIRCO PLUS-VALUE FOR CUSTOMERS

AIRCO **AIR REDUCTION**

Offices in Principal Cities

Headquarters for Oxygen, Acetylene and Other Gases . . . Calcium Carbide . . . Gas Cutting Machines . . . Gas Welding Apparatus and Supplies . . . Arc Welders, Electrodes and Accessories

News of...

ENGINEERS COMPANIES SOCIETIES

efficient service to customers in the Mid-west.

Two large industrial plants have been acquired by *Pittsburgh Mill Steel Co., Inc.*, New York City. Both plants—one located in Philadelphia, Pa., the other in Baltimore, Md.—were purchased from the General Services Administration.

A new manufacturing plant has been established in the former maintenance area of the wartime Arkansas Ordinance Works at Jacksonville, Ark., by the *Parker White Metal Co.*, Erie, Pa. This acquisition, to be known as the *Southwest Die Casting Co.*, will produce fabricated and finished metals from Arkansas aluminum. It will be under the supervision of A. E. Backus, vice president of Parker.

Carboloy Co., Inc., Detroit Mich., has just issued a new kit of six educational slidefilms, covering carbide single point tool practice, and six booklets, which contain sections from the Carboloy tool manual covering and supplementing material presented in the films. An additional booklet gives detailed instructions on how to obtain best results when using the slidefilms for group instruction. Price of the complete kit—six slidefilms and seven booklets—is $15.00. Extra copies of the booklets are available at 10c each.

Societies and Schools

The *American Institute of Mining & Metallurgical Engineers* elected Donald E. McLaughlin president of the Society for the year of 1950. Mr. McLaughlin, president of the Homestake Mining Co., will formally assume his duties at the annual meeting of the AIME, to be held Feb. 12-16, 1950 in New York City. Two vice presidents also were elected. They are: Andrew Fletcher, president of St. Joseph Lead Co.; and Robert W. Thomas, general manager of the Nevada Consolidated Copper Corp.

An exposition of modern analytical equipment will be featured at the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, which will be held in Pittsburgh, Pa., on Feb. 15-17, 1950. The meeting is sponsored jointly by the Analytical Div. of the Pittsburgh section of the *American Chemical Society* and the *Spectroscopy Society of Pittsburgh*.

During the annual meeting of the *Welding Research Council*, Dr. C. A. Adams, who has been serving as chairman of the Council since its inception, was elected honorary chairman. H. C. Boardman, for

COPPER ALLOY BULLETIN

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared Each Month by BRIDGEPORT BRASS COMPANY "Bridgeport" *Headquarters for BRASS, BRONZE and COPPER*

Methods of Machining Free-Cutting Brass Rod

Free-cutting brass rod is most commonly used for the manufacture of screw machine items. Bridgeport's Ledrite, containing 61% copper, 3.4% lead and the remainder zinc, has a machinability rating of 100. Other copper-base alloys are compared to free cutting brass rod for machinability rating.

Lead decreases ductility, thereby causing the chip to break up rapidly with a sharp reduction in heat-producing friction. These characteristics permit higher speeds and the use of a lighter cutting compound which produces greater cooling.

Cutting Tools

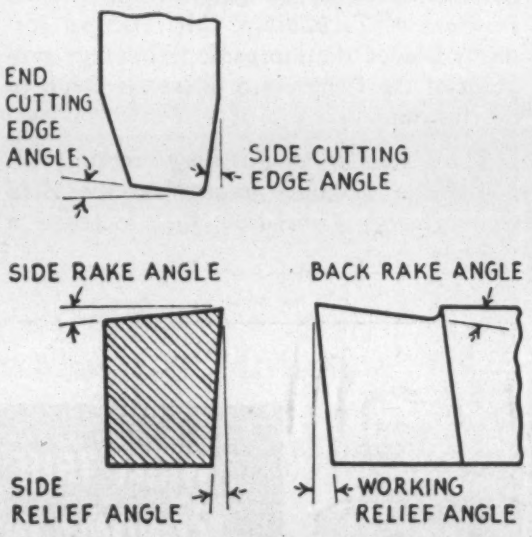
Despite the greater speeds and longer life possible with tungsten carbide tools, high-speed tools give such satisfactory service on this alloy that they are used widely in screw machine plants. Intricate forming tools are thereby produced at lower original cost. This is helpful on short runs.

Speeds and Feeds

Normal turning speeds with high-speed tools for free-cutting rod are between 300-700 surface feet per minute with a roughing feed in the neighborhood of 0.006" to 0.020". With carbide cutters, speeds up to 1000 fpm are attained with feeds of 0.005-0.025".

The low ductility of the metal permits minimum rake and clearance angles on the tool which gives greater support to the cutting edge.

TURNING TOOL NOMENCLATURE



High speeds are also possible in drilling and tapping, which means that there is no necessity for reducing speeds for these operations, with the subsequent loss in output.

Drills normally are flattened on the cutting edge to prevent hogging in by reducing the rake to zero. The rake angles on taps should also be held to a minimum.

DRILLING DATA

Clearance Angle	*Drill Point Angle*	*Cutting Edge*	*Speed Feet Per Min.*
12°-15°	118°	Flatten to 0° Rake	200-500

REAMING DATA

Back Rake	*Clearance*	*Land*	*Speed*
0°	6°-8°	5°-10°	100-200

TAPPING DATA

Rake	*Chamfer*	*Coolant*
2°-4°	10°-15° Two or Three Threads	Soluble Oil, Light Mineral Oil

TURNING DATA

	Tool Grinding				Speeds and Feeds for Turning			Coolant
70-100 Machinability	*Relief Angles Degrees* Side	Working	*Rake Angles Degrees* Back	Side	*Surface Speed Ft. per Min.*	*Roughing Feed*	*Finishing Feed*	
HS Steel Tool	0-5	6	0	0-3	300-700	0.006-0.020	0.003-0.015	Light Mineral or Soluble Oil
Carbide Tipped Tool	4-6	4-6	0	2-6	500-1000	0.015-0.025	0.005-0.015	

Coolant-Lubricant

For a coolant-lubricant either a light mineral oil or soluble oil in the ratio of 25 parts water to 1 of oil is satisfactory. At high speeds, however, it is important that the stream or streams of cutting compounds do not splash off work and tools. Normally the outlets are fish-tailed to spread the coolant and also reduce the pressure at the nozzle.

Where considerable threading or tapping is involved, low mineral oils are generally used although the soluble oil solution can be enriched by reducing the proportions of water to oil.

Cold-Working Operations

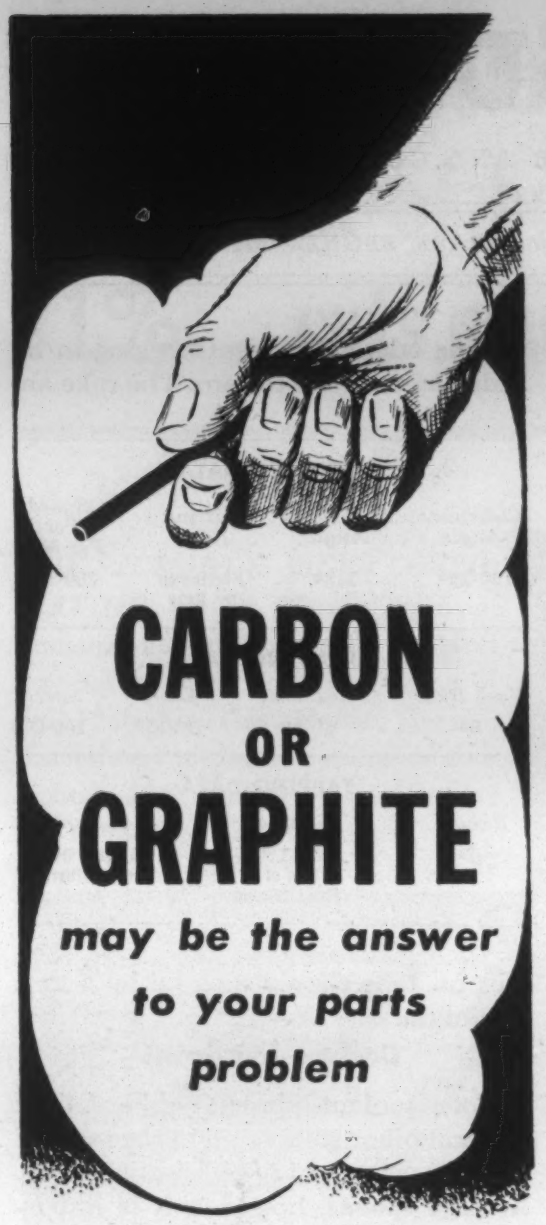
Cold swaging or other cold working operations cannot be carried out to any great degree on this highly-leaded material. For this reason Ledrite 2 has been developed. There is 63% copper, 1.8% lead and the remainder zinc in this alloy. Operations such as roll threading, knurling, forming and expanding can be carried out on this alloy yet the machinability rating is high.

Bridgeport rod has many other fine features—accurate gauge, fine surface, uniformly excellent quality. When a special problem presents itself, consult our Laboratory.

BRASS · BRONZE · COPPER · DURONZE — STRIP · ROD · WIRE · TUBING

MILLS IN
BRIDGEPORT, CONNECTICUT
INDIANAPOLIS, INDIANA
In Canada:
Noranda Copper and Brass Limited, Montreal

BRIDGEPORT BRASS COMPANY
BRIDGEPORT 2, CONNECTICUT
Established 1865
"Bridgeport" *District Offices and Warehouses in Principal Cities*



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to your parts
problem

High friction...undue corrosion...poor thermal conductivity...these are just a few of the problems that Speer engineers are helping to lick every day.

Why not take advantage of this experience? You may find carbon or graphite components – either molded, extruded, or machined – one answer to your parts problems. Inertness, low coefficients of expansion, light weight and the relatively low cost of these time-honored materials are advantages that find application in new and improved products *constantly*.

For more than 50 years now, Speer has been making carbon and graphite products...a leader in the industry. Speer's modern experimental and testing laboratories are always available for the analysis of your problems. Write today for further information.

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Speer
CARBON COMPANY
ST. MARYS, PENNA.

News of... ENGINEERS COMPANIES SOCIETIES

merly vice chairman, assumed the chairmanship, and Dr. A. B. Kinzel was elected vice chairman. Dr. Adams was the first director of the American Bureau of Welding, which position he held until the Bureau was discharged and the Council organized. Mr. Boardman is research director of the Chicago Bridge & Iron Co., and Dr. Kinzel is president of the Union Carbide & Carbon Research Laboratories, Inc.

The *Colorado School of Mines Research Foundation, Inc.* has appointed Vernon L. Mattson as director of the Foundation.

Clifford A. Hampel has been named supervisor of extraction metallurgy at the *Armour Research Foundation* of the *Illinois Institute of Technology*. Mr. Hampel formerly headed the inorganic technology program of the Ceramics & Minerals Dept. of the Institute.

The *University of Pittsburgh* recently announced a $20,000 grant from the *Acid Open Hearth Association, Inc.*, to renew a research program in the Metallurgical Engineering Dept. Dr. G. R. Fitterer, head of the Metallurgical Engineering Dept., is director of the program, which deals with the refining problems in the acid open hearth method of handling liquid steel.

Construction has begun on the Alumni Scientific Laboratories, the first of five structures contemplated by the *Drexel Institute of Technology*. The building is to be dedicated to the Drexel alumni in recognition of their leadership in the expansion effort.

Verne H. Schnee, formerly assistant director of Battelle Memorial Institute, has been named director of the *University of Oklahoma Research Institute*.

The Copper & Brass Research Association has become an industrial member of the *University of Chicago's Institute for the Study of Metals*, one of three Institutes that constitute the country's largest privately supported research program in nuclear studies and metals.

George V. Luerssen and Dr. Carl B. Post, metallurgists for the Carpenter Steel Co., were honored by the *American Institute of Mining & Metallurgical Engineers* at the Society's recent annual meeting. The award was made in recognition of an outstanding contribution to the steel industry.

The *University of Massachusetts* recently dedicated the Gunness Engineering Laboratory, named for Christian I. Gunness, late head of engineering at the University.

WANT TRUE ECONOMY IN MOLDED PLASTICS?

CALL THE WATERTOWN MAN

There are so many plastics, so many design factors, so many angles involved in choosing from among the different molding methods that it pays to get the best, most experienced help with your custom molding jobs.

This help is available from the Watertown man virtually on your doorstep. He's backed by our 34 years experience and complete facilities, including a laboratory second to none in the industry, to develop, produce and test your part or product to your satisfaction . . . and your customers'.

If you have a custom molded plastics job on blueprints . . . or merely in mind . . . phone your nearest Watertown man today . . . or phone or write us directly. Here are the Watertown men . . .

New York—H. A. Rankow, 175 Fifth Ave.
Chicago—National Insulations Co.,
2808 W. Lake St.
G. W. Glaescher
J. P. Bonnamy
R. C. Farquhar
J. R. Kallaher
J. P. Greener
Detroit—J. P. Greener from Chicago
Cleveland—Carl F. Linn, 866 Hanna Bldg.
Milwaukee—Roger L. Miller, 729 N. Broadway
Seattle—John W. Witherow, National Vulcanized Fibre Co. 1927 First Ave., South
San Francisco—G. W. Harmssen, National Vulcanized Fibre Co. 273 Seventh Ave.
Los Angeles—Fred M. Foley, National Vulcanized Fibre Co. 2325 East Eighth St.

THE WATERTOWN MANUFACTURING CO.
600 ECHO LAKE RD., WATERTOWN, CONN.

Improved Sag Resistance
makes Thinner Gauges Practical

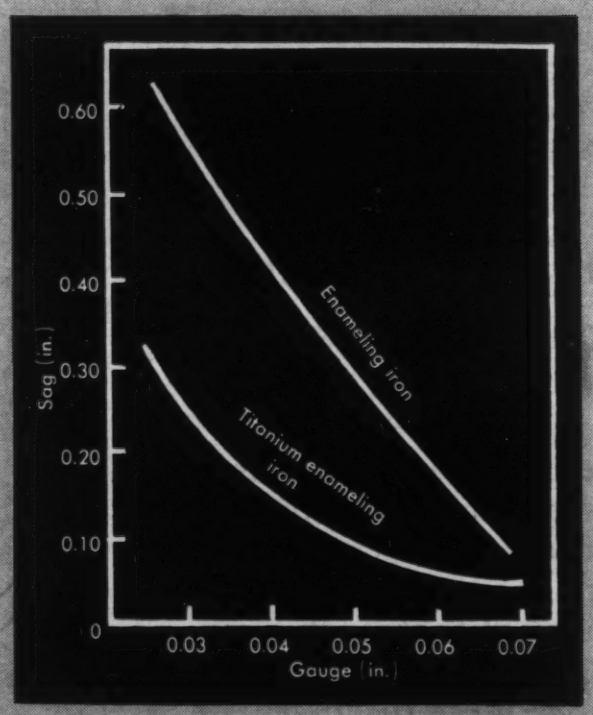
TITANIUM IRON for vitreous ENAMELING

The improved sag resistance of Titanium-bearing Enameling Iron makes it possible to avoid firing-distortion with lighter gauge sheets. This is a worthwhile economy that enamelers are using to advantage. In addition to sag and warp resistance, Titanium Enameling Iron, containing sufficient titanium to stabilize all the carbon, offers other desirable properties:

1 **GROUND COATS ELIMINATED:** Under proper shop conditions, cover coats may be applied directly to the base metal. These thin opaque coats reduce the hazards of chipping and breaking. Adhesion is excellent.

2 **FISHSCALING AND BOILING REDUCED:** During years of research and production, not one case of fishscaling has been reported. Blisters in the finished enamel are also eliminated.

3 **PRODUCTS MORE ATTRACTIVE:** In fabricated shapes warping, wrinkling and stretcher strains are avoided because of the increased sag resistance and excellent drawing qualities of Titanium Enameling Iron.



The Titanium Alloy Mfg. Division developed this new enameling process and produces the titanium alloy used in the manufacture of this enameling iron. For samples see your steel supplier. Detailed technical information may be obtained from our field engineers by writing to our New York Office.

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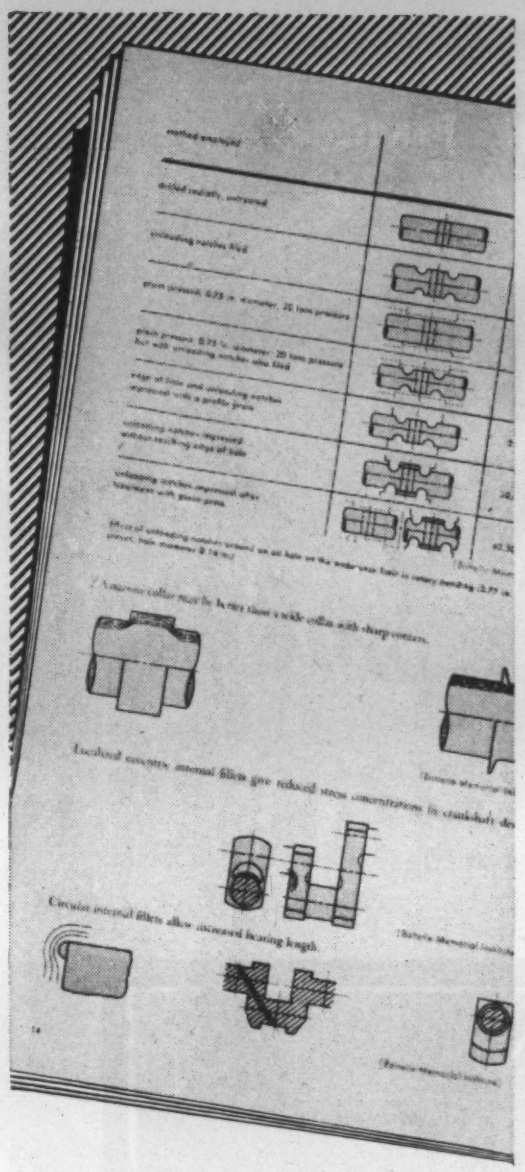

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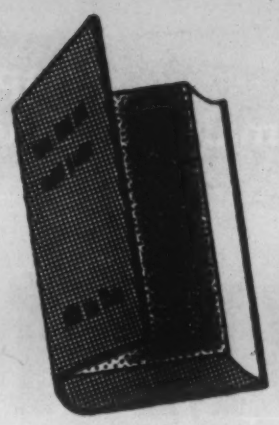

BOOK REVIEWS

Magnesium

THE STORY OF MAGNESIUM. *By W. H. Gross. Published by the American Society for Metals, Cleveland 3, Ohio, 1949. Cloth, 5¼ by 7¾ in., 260 pages. Price $2.00.*

Designed for the layman, rather than the scientific or trained specialist, this highly readable book describes the production of magnesium, the properties of the metal and its alloys, and its fabrication into finished forms and products.

Casting, forming, machining, joining, surface finishing, riveting and welding of magnesium are all covered. Over 100 illustrations and diagrams have been added to increase the value of this reference.

Of wide general interest are the first two chapters dealing with the history and occurrence of magnesium and its economic importance today. A glossary of technical terms is included as a further aid to the non-technical reader.

Despite the layman slant given this book, it should also prove helpful to the technical man as a summary of present-day knowledge of magnesium and its alloys. Although the author is connected with Dow Chemical Co., one of the largest magnesium producers, the information in this book has been taken from a large number of additional sources.

Titanium in Steel

TITANIUM IN STEEL. *By George F. Comstock, Stephen F. Urban and Morris Cohen. Published by Pitman Publishing Corp., New York 19, N. Y., 1949. Cloth, 6¼ by 9¼ in., 320 pages. Price $7.50.*

Generally patterned after the well-known Alloys of Iron Series, this book is a correlation and critical summary of available data on the use of titanium as a deoxidizer, as a carbon-and-nitrogen-stabilizing element, and as an alloying metal in steel. Unlike the monographs on the more common alloying elements, however, this volume is not intended as a complete review of the literature; since it is only recently that the physical chemistry underlying the reactions of titanium with other elements in steel has been understood, many of the earlier papers are now obsolete. The authors have, therefore, emphasized the more recent and accurate data, presenting them in sufficient detail so that it should be unnecessary for the reader to consult the original literature. Nevertheless, an extensive bibliography, arranged chronologically, has been appended.

The general subjects discussed in this volume are as follows: preparation and general properties of titanium metal and master alloys; physical chemistry of titanium in steel; phase diagrams of titanium alloys and compounds; titanium in rimming and deoxidized steels, in cast steel, in low-alloy steels, in precipitation-hardening steels, and in heat resisting steels and alloys; effect of titanium on structure, hardenability, mechanical properties, and strain aging; titanium enameling steel; and carbide stabilization of stainless steel with titanium.

Good type-face selection and generous use of illustrative material, including graphs, tables and photomicrographs, make this volume as aesthetically attractive as it is technically competent.

Design and Fabrication of Light Metals

ALUMINUM AND MAGNESIUM DESIGN AND FABRICATION. *By R. Burt Schuh... Published by McGraw-Hill Book Co., New York, 1949. Cloth, 6¼ by 9¼ in., 5... pages. Price $7.50.*

Widespread use of light metals during war time has resulted in a mass of data on design and fabrication of parts of aluminum and magnesium. This book, written by the supervisor of manufacturing research at Glenn L. Martin Co., is an attempt to organize and present this information with the emphasis on material not readily available elsewhere.

Underlining the practical approach to light metal processing is the inclusion of an extensive chapter on cost analysis, in which detailed economic data on various forming methods are listed. The author also devotes seven chapters to limited-production forming methods, including discussions of equipment such as the router, shaper, press brake, rubber hydraulic press, hydraulic press, mechanical press, drop hammer, contour roll former and stretch press.

Other topics covered are: characteristics and forms of aluminum and magnesium; light metal properties and theory of forming; machining operations; forming methods used in experimental and mass production; mechanical, welded and bonded fastenings; and general design principles and applications.

The book contains a large number of informative illustrations in the form of tables, drawings and photographs.

Other New Books

METALS REFERENCE BOOK. *By C. J. Smithells. Published by Interscience Publishers, Inc., New York 3, N. Y., 1949. Cloth, 6¼ by 9½ in., 735 pages. Price $13.50.* A convenient summary of data relating to metallurgy and metal physics, presented in the form of tables or diagrams with a minimum of descriptive matter.

THE CREEP OF METALS AND ALLOYS. *By E. G. Stanford. Published by Temple Press, Ltd., London E. C. 1, England, 1949. Cloth, 5¾ by 8¼ in., 162 pages. Price 15s.* A survey of published information on the technique adopted in the measurement of creep of metals and alloys.